SOIL SURVEY OF

Red River County, Texas

United States Department of Agriculture
Soil Conservation Service

In cooperation with
Texas Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1957-70. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Red River Soil and Water Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Red River County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit, pasture and hayland group, woodland suitability group, and woodland grazing group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, the pasture and hayland groups, the woodland suitability groups, and the woodland grazing groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for recreation in the section "Recreational Development."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Red River County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county in the section "Environmental Factors Affecting Use of the Soils."

Cover: Coastal bermudagrass hay meadow in an area of Austin silty clay, 1 to 3 percent slopes.

Contents

	Page
How this survey was made	1
General soil map	2
Nearly level to moderately steep forested soils of terraces and uplands	2
1. Woodtell-Wrightsville-Annona association	2
2. Wrightsville-McKamie association	3
3. Kullit-Bernaldo association	4
4. Whakana-Vesey association	4
5. Woodtell-Kullit association	4
Nearly level and gently sloping prairie soils of uplands	5
6. Burleson-Deport association	5
7. Houston Black-Austin association	5
Nearly level and gently sloping forested soils of bottom lands	5
8. Kaufman-Gladewater association	5
9. Oklared-Desha association	6
Descriptions of the soils	6
Addielou series	6
Annona series	7
Austin series	8
Bernaldo series	9
Bryarly series	10
Burleson series	11
Crockett series	12
Cuthand series	12
Deport series	13
Desha series	14
Ellis series	14
Elysian series	15
Ferris series	15
Freestone series	16
Gladewater series	17
Hapludalfs, loamy	19
Houston Black series	19
Kaufman series	20
Kenney series	20
Kiomatia series	21
Kullit series	22
Mabank series	23
McKamie series	23
Morse series	24
Muldrow series	25
Nahatche series	26
Oklared series	26
Panola series	27
Redlake series	27
Rodessa series	28
Roebuck variant	29
Rosalie series	29
Thenas series	30
Trinity series	31
Varro series	32
Vesey series	32
Waskom series	33
Whakana series	34
Woodtell series	36
Wrightsville series	37
Use and management of the soils	38
Cropland	38
Capability grouping	39
Predicted yields	43
Pasture and hayland	45
Pasture and hayland groups	47
Woodland	49
Woodland suitability groups	58
Woodland grazing	60
Woodland grazing groups	61
Wildlife	62
Recreational development	65
Engineering uses of the soils	65
Engineering soil classification systems	82
Soil properties significant in engineering	82
Engineering interpretations	83
Soil test data	84
Formation and classification of the soils	85
Factors of soil formation	85
Parent material	85
Climate	85
Plant and animal life	85
Relief	85
Time	86
Processes of soil horizon differentiation	86
Classification of soils	86
Environmental factors affecting use of the soils	88
Climate	88
Geology	89
Relief and drainage	90
Farming	90
Transportation and markets	90
Water supply	90
Glossary	91
Guide to mapping units	Following 92

ISSUED FEBRUARY 1977

SOIL SURVEY OF RED RIVER COUNTY, TEXAS

BY JESSE R. THOMAS, JR., SOIL CONSERVATION SERVICE

SOILS SURVEYED BY JOE P. CLUTTER, GORDON S. McKEE, ROY L. ROBBINS, AND JESSE R. THOMAS, JR., SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH
TEXAS AGRICULTURAL EXPERIMENT STATION

RED RIVER COUNTY is in northeastern Texas (fig. 1). It has a total area of 662,400 acres, or 1,035 square miles, 1,216 acres of which is water. Clarksville, the county seat, has a population of 3,850.

Red River County is bounded on the north by Oklahoma, on the east by Bowie County, on the south by Titus and Franklin Counties, and on the west by Lamar County. The economy of the county is based largely on farming. Cotton was the main crop for almost 100 years, but during the last 50 years, most of the cropland has been converted to pasture and woodland. Although the economy is still based mainly on farming, a few industries are located in Clarksville.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Red River County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

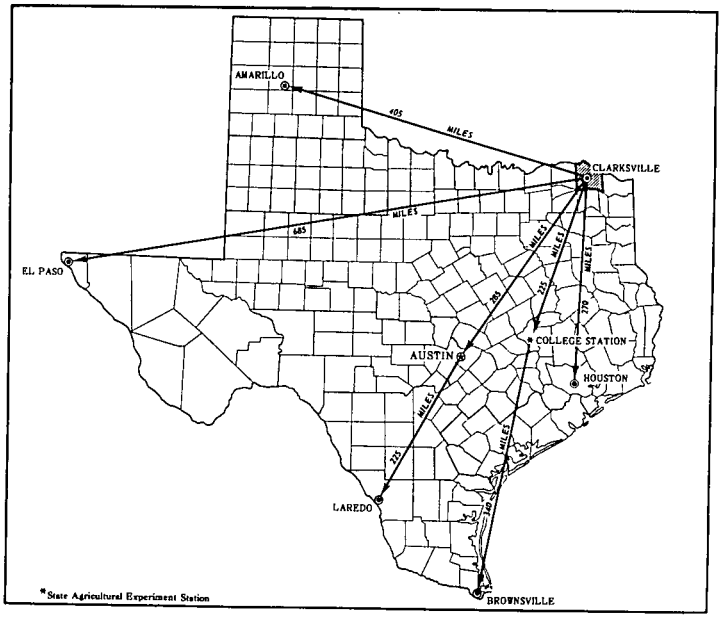


Figure 1.—Location of Red River County in Texas.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles that are almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Cuthand and Kiomatia, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Burleson clay, 0 to 1 percent slopes, is one of two phases within the Burleson series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field

borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Red River County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Annona-Freestone complex, 1 to 3 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. Redlake soils is an example in Red River County.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Red River County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one less extensive soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to those who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities, or community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management .

The soil associations in Red River County are discussed in the following pages.

The soil associations in this survey have been grouped into three general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the soil associations in each group are described in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association 9, the words "loamy and clayey" refer to the texture of the surface layer.

Nearly Level to Moderately Steep Forested Soils of Terraces and Uplands

This group consists of deep, acid soils. About 60 percent of the acreage is wooded, about 35 percent is used for pasture, and about 5 percent is used for crops. The woodland is mainly hardwood and pine, and the understory is used for grazing. Most of the soils of this group are well suited to woodland and to use as wildlife habitat. Many of the soils are suited to pasture and to recreation. Some of the soils that are well drained are suited to crops.

1. Woodtell-Wrightsville-Annona association

Moderately well drained to poorly drained, very slowly permeable, loamy soils

This association consists of nearly level to gently sloping soils on uplands and terraces and of strongly sloping soils along drainageways (fig. 2).

The association makes up about 46 percent of the county. It is about 31 percent Woodtell soils, 14 percent

Wrightsville soils, 9 percent Annona soils, and 46 percent less extensive soils.

Woodtell soils are moderately well drained. They are gently sloping to strongly sloping and moderately eroded to severely eroded. The surface layer is dark grayish-brown fine sandy loam about 6 inches thick. The next layer is 6 inches of yellowish-red clay mottled with light yellowish brown. The next layer is 17 inches of red clay mottled with gray and yellowish red. Below this is 16 inches of yellowish-brown clay loam mottled with gray and red. The underlying material to a depth of 72 inches is stratified light olive-gray and gray sandy clay loam and yellowish-brown clay loam.

Wrightsville soils are on stream divides. These soils are nearly level, poorly drained, and slightly eroded. The surface layer is very fine sandy loam about 11 inches thick. The upper 2 inches is dark grayish brown, and the lower 9 inches is light gray and is mottled with dark yellowish brown. Below this is gray clay that extends to a depth of 51 inches. It has penetrations of loam in the upper 10 inches and is mottled with dark yellowish brown to a depth of about 40 inches. The underlying material to a depth of 86 inches is light-gray clay mottled with dark yellowish brown.

Annona soils are on stream divides. These soils are gently sloping, somewhat poorly drained, and moderately eroded. The surface layer is loam about 10 inches thick. The upper 5 inches is dark grayish brown, and the lower 5 inches is light yellowish brown. The next layer is 30 inches of mottled clay that is dark red in the upper part and gray in the lower part. Below this to a depth of about 95 inches is yellowish-brown clay mottled with gray.

Less extensive in this association are Panola, Kullit, Freestone, Rodessa, and Addielou soils. Panola soils occupy slightly lower positions on the landscape, and the other soils occupy slightly higher positions.

This association is not well suited to most crops grown in the county, but most areas of the association are suited to pasture and hay. About 65 percent of the acreage is wooded, about 30 percent is used for pasture and hay, and about 5 percent is used for crops. The lower lying, poorly drained areas are better suited to woodland and wildlife habitat than to most other uses.

2. *Wrightsville-McKamie association*

Poorly drained and well drained, very slowly permeable, loamy soils

This association consists of broad, nearly level to strongly sloping soils on terraces that are dissected by streams.

The association makes up about 12 percent of the county. It is about 38 percent Wrightsville soils, 12 percent McKamie soils, and 50 percent less extensive

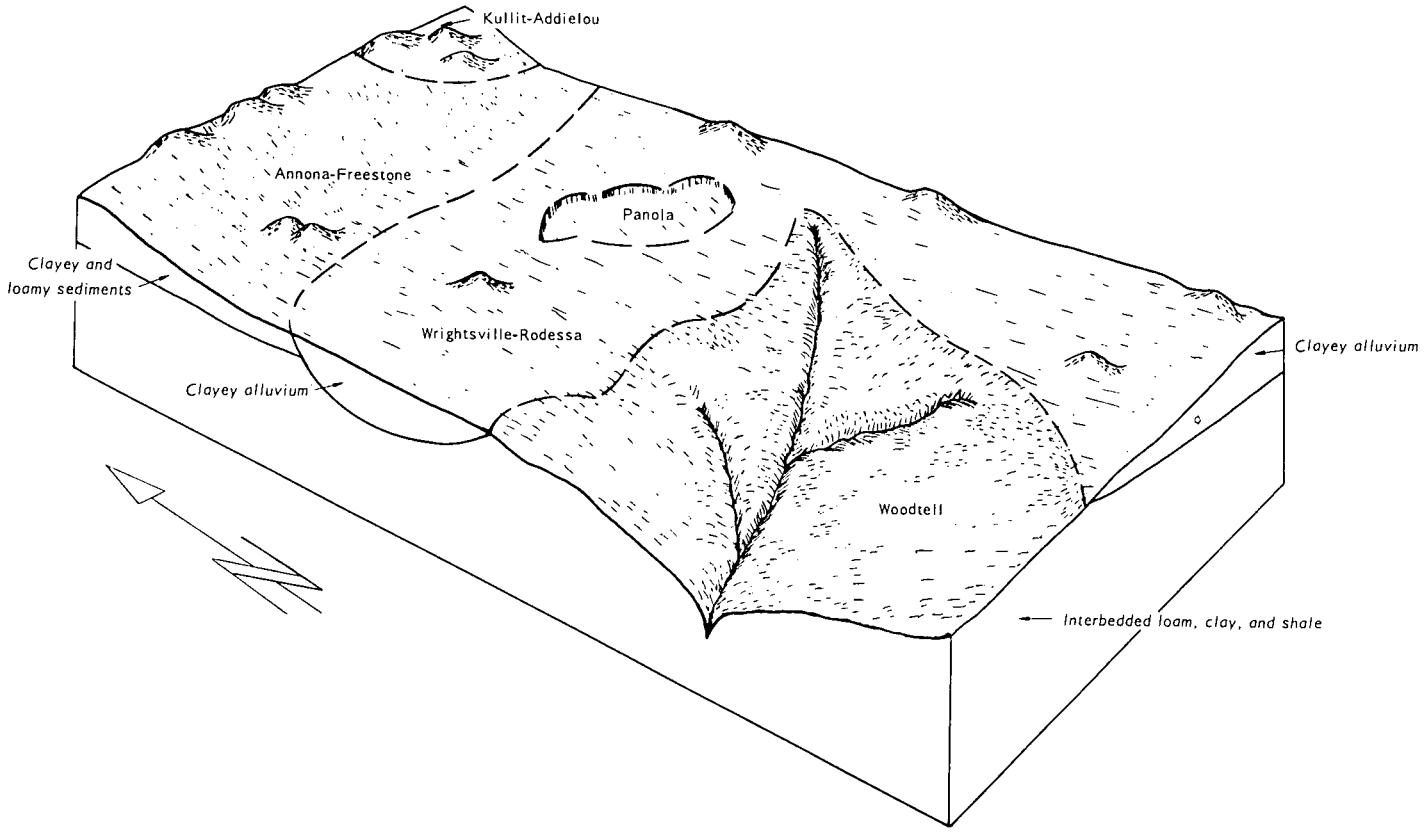


***Figure 2.*—Pattern of soils in the Woodtell-Wrightsville-Annona association.**

soils.

Wrightsville soils are poorly drained. They are smooth, nearly level, and slightly eroded. The surface layer is very fine sandy loam about 11 inches thick. The upper 2 inches is dark grayish brown, and the lower 9 inches is light gray and is mottled with dark yellowish brown. Below this is gray clay that extends to a depth of 51 inches. It has penetrations of loam in the upper 10 inches and is mottled with dark yellowish brown in the lower 29 inches. The underlying material to a depth of 86 inches is light-gray clay mottled with dark yellowish brown.

McKamie soils are well drained. They are gently sloping to strongly sloping and are moderately eroded to severely eroded. The surface layer is loam about 9 inches thick. It is dark brown in the upper 6 inches and brown in the lower 3 inches. Below this is about 27 inches of red clay. The underlying material to a depth of 65 inches is reddish-brown, stratified loam, silty clay loam, and clay.

Less extensive in this association are Whakana, Kullit, Vesey, and Addielou soils. All of these soils occupy the higher positions on the landscape. Also in this association are Rodessa soils, which occur on mounds and are closely associated with Wrightsville soils.

This association is not well suited to most crops grown in the county. About 70 percent of the acreage is wooded. Most areas of Wrightsville soils have never been cleared. About 25 percent of the acreage is used for pasture and hay, and about 5 percent is used for crops.

3. *Kullit-Bernaldo association*

Moderately well drained and well drained, moderately slowly permeable and moderately permeable, loamy soils

This association consists of gently sloping soils on uplands and terraces.

The association makes up about 7 percent of the county. It is about 46 percent Kullit soils, 23 percent Bernaldo soils, and 31 percent less extensive soils.

Kullit soils are moderately well drained. They are gently sloping and moderately eroded. The surface layer is brown fine sandy loam about 5 inches thick. The next layer is 9 inches of strong-brown sandy clay loam mottled with yellowish red. The next layer is 24 inches of clay loam. The upper 7 inches is strong-brown and is mottled with gray and yellowish red. The lower 17 inches is light gray, is mottled with red and yellowish brown and contains cracks and channels filled with uncoated sand. Below this to a depth of 90 inches is light-gray clay that is mottled with red and yellowish brown and has a few cracks filled with uncoated sand.

Bernaldo soils are well drained. They are gently sloping and moderately eroded. The surface layer is brown fine sandy loam about 10 inches thick. The next layer is 40 inches of yellowish-brown sandy clay loam mottled with red and light brownish gray in the lower part. Below this to a depth of 93 inches is yellowish-brown clay loam mottled with yellowish red and gray.

Less extensive in this association are Elysian soils, which occur on mounds within areas of Bernaldo fine sandy loam, and Addielou soils, which occur on mounds within areas of Kullit fine sandy loam.

This association is well suited to most crops grown in the county. About 70 percent of the acreage is used for pasture, 20 percent is wooded, and 10 percent is used for crops.

4. *Whakana-Vesey association*

Well drained, moderately permeable, loamy soils

This association consists of nearly level to moderately steep soils on terraces.

The association makes up about 2 percent of the county. It is about 49 percent Whakana soils, 26 percent Vesey soils, and 25 percent less extensive soils.

Whakana soils are nearly level to sloping and are slightly eroded to moderately eroded. The surface layer is brown loam about 9 inches thick. The next layer is 5 inches of brown loam. The next layer is 10 inches of yellowish-red clay loam that has mottles of red and contains pockets of strong-brown loamy sand. The next layer is 10 inches of brown clay loam mottled with red and dark reddish brown. The next layer is 12 inches of dark-red loam. The next layer is 17 inches of red loam that has streaks of uncoated sand on vertical faces. Below this to a depth of 80 inches is yellowish-red sandy clay loam.

Vesey soils are gently sloping to moderately steep and are slightly eroded. The surface layer is fine sandy loam about 24 inches thick. The upper 8 inches is dark brown, and the lower 16 inches is yellowish brown. The next layer is 38 inches of yellowish-red sandy clay loam. The next layer is 7 inches of reddish-yellow loam. Below this to a depth of 68 inches is red sandy loam mottled with light yellowish brown and reddish yellow.

Less extensive in this association are Kullit and Bernaldo soils. Both of these soils occupy the higher positions on the landscape.

The association is suited to most crops grown in the county. About 60 percent of the acreage is used for pasture and hay, 30 percent is wooded, and 10 percent is used for crops.

5. *Woodtell-Kullit association*

Moderately well drained, very slowly permeable and moderately slowly permeable, loamy soils

This association consists of gently sloping to strongly sloping soils.

The association makes up about 1 percent of the county. It is about 49 percent Woodtell soils, 33 percent Kullit soils, and 18 percent less extensive soils.

Woodtell soils are gently sloping to strongly sloping and are moderately eroded to severely eroded. The surface layer is dark grayish-brown fine sandy loam about 6 inches thick. The next layer is 6 inches of yellowish-red clay mottled with light yellowish brown. The next layer is 17 inches of red clay mottled with gray and yellowish red. The next layer is 16 inches of yellowish-brown clay loam mottled with gray and red. The underlying material to a depth of 72 inches is stratified light olive-gray and gray sandy loam and yellowish-brown clay loam.

Kullit soils are gently sloping and moderately eroded. The surface layer is brown fine sandy loam about 5 inches thick. The next layer is 9 inches of strong-brown sandy clay loam mottled with yellowish red. The next layer is 24 inches of clay loam. The upper 7 inches is strong brown and is mottled with gray and yellowish red; the lower 17 inches is light gray, has red and yellowish-brown mottles, and contains cracks and channels filled with uncoated sand. Below this to a depth of 90 inches is light-gray clay mottled with red and yellowish brown. It has a few cracks filled with uncoated sand.

Less extensive in this association are Annona and Bernaldo soils. Annona soils occupy the lower positions on the landscape, and Bernaldo soils occupy the higher positions.

This association is suited to most crops grown in the county. It is well suited to pasture and hay. The areas of steeper slopes are better suited to use as woodland and wildlife habitat. About 75 percent of the acreage is used for pasture and hay, 15 percent is wooded, and 10 percent is used for crops.

Nearly Level and Gently Sloping Prairie Soils of Uplands

This group consists of deep or moderately deep, acid and alkaline, clayey soils. About 50 percent of the acreage is used for pasture, 42 percent is used for crops, and 8 percent is wooded. Most of the soils of this group are well suited to pasture but poorly suited to woodland. They are also suited to crops and open-land wildlife habitat. Most of the soils in this group have a high shrink-swell potential that presents problems in the construction of buildings, roads, streets, and pipelines.

6. Burleson-Deport association

Moderately well drained and somewhat poorly drained, very slowly permeable, clayey soils

This association consists of broad, nearly level to gently sloping soils.

The association makes up about 12 percent of the county. It is about 34 percent Burleson soils, 24 percent Deport soils, and 42 percent less extensive soils.

Burleson soils are moderately well drained. They are smooth, nearly level, slightly eroded soils on ridgetops. The surface layer is clay about 56 inches thick. The upper 24 inches is very dark gray, and the lower 32 inches is dark gray. The next layer is 12 inches of dark-gray clay. Below this to a depth of 87 inches is mottled yellowish-brown, light-gray, and gray clay that contains fragments of shale.

Deport soils are somewhat poorly drained. They are gently sloping and moderately eroded soils on side slopes. The surface layer is very dark gray clay about 6 inches thick. The next layer is 51 inches thick. The upper 31 inches is dark-gray or gray clay mottled with dark grayish brown and yellowish brown, and the lower 20 inches is olive-brown clay mottled with gray and yellowish brown. The underlying material to a depth of 68 inches is brownish-yellow and light brownish-gray shale.

Less extensive in this association are Ellis, Ferris, and Mabank soils. Ellis and Ferris soils occupy the higher positions on the landscape, and Mabank soils occupy the lower positions.

This association is suited to most crops grown in the county. It is well suited to pasture and hay, but it is not suited to commercial woodland. About 45 percent of the acreage is used for crops, 45 percent is used for pasture and hay, and 10 percent is wooded.

7. Houston Black-Austin association

Moderately well drained and well drained, very slowly permeable and moderately slowly permeable, clayey soils

This association consists of gently sloping soils.

The association makes up about 5 percent of the county. It is about 46 percent Houston Black soils, 18 percent Austin soils, and 36 percent less extensive soils.

Houston Black soils are moderately well drained. They are gently sloping and moderately eroded. The surface layer is black clay about 20 inches thick. The next layer is 49 inches of clay. It is very dark gray in the upper 24 inches and dark gray in the lower 25 inches. The underlying material to a depth of 72 inches is shale.

Austin soils are well drained. They are gently sloping and moderately eroded. The surface layer is very dark grayish-brown silty clay about 11 inches thick. The next layer is 26 inches of grayish-brown silty clay. It is mottled with very dark grayish brown in the upper 9 inches and light olive brown in the lower 17 inches. The underlying material to a depth of 50 inches is interbedded light-gray silty clay and chalk.

Less extensive in this association are Bryarly, Burleson, and Ferris soils. Bryarly soils occupy narrow side slopes next to drainageways. Burleson soils are on slightly less well drained positions, and Ferris soils are on steeper side slopes.

This association is suited to most crops grown in the county and to pasture and hay. It is not suited to commercial woodland. About 40 percent of the acreage is used for crops, and 60 percent is used for pasture.

Nearly Level and Gently Sloping Forested Soils of Bottom Lands

This group consists of deep, alkaline and acid soils. About 50 percent of the acreage is used for pasture, 42 percent is wooded, and about 8 percent is used for crops. Most of the soils of this group are well suited to pasture, woodland, and wildlife habitat. Where the hazard of flooding can be controlled, some of the soils of this group are well suited to crops.

8. Kaufman-Gladewater association

Somewhat poorly drained and poorly drained, very slowly permeable, clayey soils

This association consists of nearly level flood plains of major rivers of the county and their tributaries. Areas of the soils are long and narrow and parallel the streams.

The association makes up about 9 percent of the county. It is about 50 percent Kaufman soils, 29 percent Gladewater soils, and 21 percent less extensive soils.

Kaufman soils are somewhat poorly drained. They are smooth, nearly level, and slightly eroded. The surface layer is very dark gray clay about 15 inches thick. Below this to a depth of 70 inches is dark-gray clay mottled with strong brown and light olive brown.

Gladewater soils have a surface layer of very dark gray clay about 6 inches thick. The next layer is 34 inches of clay. The upper 18 inches is light brownish gray and is mottled with yellowish brown. The lower 16 inches is gray and is mottled with yellowish brown. The underlying material to a depth of 65 inches is gray clay stratified with gray clay loam. It is mottled with yellowish brown.

Less extensive in this association are Varro and Nahatche soils. These soils occupy the higher positions on the landscape.

Most of this association is wooded or is used for pasture. A small part of the acreage is protected by levees and is used for crops. This association is suited to crops if flooding is controlled and proper drainage systems are installed. It is better suited to pasture, woodland, and wildlife habitat than to most other uses.

9. *Oklared-Desha association*

Well drained and somewhat poorly drained, moderately rapidly permeable and very slowly permeable, loamy and clayey soils

This association consists of nearly level to gently sloping soils.

The association makes up about 6 percent of the county. It is about 31 percent Oklared soils, 24 percent Desha soils, and 43 percent less extensive soils.

Oklared soils are well drained. They are nearly level and slightly eroded. The surface layer is reddish-brown fine sandy loam about 10 inches thick. The underlying material extends to a depth of 65 inches. The upper 5 inches is reddish-brown fine sandy loam, the next 10 inches is reddish-brown very fine sandy loam, and the lower 40 inches is reddish-brown and light reddish-brown fine sandy loam.

Desha soils are somewhat poorly drained. They are nearly level to gently sloping and slightly eroded to moderately eroded. The surface layer is dark reddish-brown clay about 28 inches thick. It is mottled with dark reddish brown in the lower 22 inches. Below this to a depth of 96 inches is clay. The upper 32 inches is dark brown, and the lower 36 inches is dark reddish brown and contains a few concretions of calcium carbonate.

Less extensive in this association are Redlake, Muldrow, Waskom, Kiomatia, and Whakana soils.

This association is suited to most crops grown in the county. About 20 percent of the acreage is used for crops, about 50 percent is used for pasture and hay, and about 30 percent is wooded. In many formerly cropped areas, trees have been allowed to return.

Descriptions of the Soils

This section describes the soil series and mapping units in Red River County. Each soil series is described in detail, and then each mapping unit in that series is briefly described. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile; that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described as representative of the series, these differences are stated in the description of the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Hapludalfs, loamy, 0 to 2 percent slopes, for example, do not belong to a soil series, but they are listed in alphabetic order with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, pasture and hayland group, and woodland suitability group in which the mapping unit has been placed. The page for the descriptions of each capability unit or other interpretative group can be learned by referring to the Guide to Mapping Units at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual.[1]

Addielou Series

The Addielou series consists of deep, nearly level to gently sloping, loamy, acid soils on uplands. These soils formed mainly in loamy ancient alluvium on old stream terraces.

In a representative profile the surface layer is fine sandy loam about 28 inches thick. The upper 8 inches is brown, and the lower 20 inches is light yellowish brown. The next layer is 20 inches of yellowish-brown

[1] UNITED STATES DEPARTMENT OF AGRICULTURE. Soil Survey Manual. Agr. Handb. No. 18, 503 pp., illus., 1951. [Supplement issued in May 1962]

TABLE 1.—*Approximate acreage and proportionate extent of soils*

Soil	Acres	Percent	Soil	Acres	Percent
Annona-Freestone complex, 1 to 3 percent slopes	46,800	7.0	Morse clay, 3 to 8 percent slopes, eroded	680	0.1
Austin silty clay, 1 to 3 percent slopes	5,970	.9	Muldrow silty clay loam	3,280	.5
Bernaldo-Elysian complex, 1 to 3 percent slopes	16,470	2.4	Muldrow-Elysian complex	1,990	.3
Bryarly clay loam, 1 to 5 percent slopes	10,960	1.7	Nahatche soils, frequently flooded	14,950	2.3
Burleson clay, 0 to 1 percent slopes	3,670	.6	Oklared fine sandy loam	10,120	1.6
Burleson clay, 1 to 3 percent slopes	24,080	3.6	Oklared silty clay loam	2,470	.4
Crockett loam, 1 to 3 percent slopes	4,810	.8	Panola silty clay	29,000	4.4
Cuthand loam, 4 to 8 percent slopes, eroded	4,230	.6	Redlake clay	2,580	.4
Deport clay, 1 to 3 percent slopes	19,400	2.9	Redlake soils	2,290	.3
Desha clay, 0 to 1 percent slopes	8,470	1.3	Roebuck clay, calcareous variant	1,860	.3
Desha clay, 1 to 3 percent slopes	1,090	.2	Rosalie loamy fine sand, 2 to 5 percent slopes	7,820	1.2
Ellis clay, 3 to 5 percent slopes	6,520	1.0	Thenas fine sandy loam, frequently flooded	18,740	2.8
Ferris clay, 3 to 8 percent slopes, eroded	10,340	1.6	Trinity clay	4,030	.6
Freestone-Addielou complex, 0 to 1 percent slopes	5,540	.8	Trinity clay, frequently flooded	6,030	1.0
Gladewater clay	3,010	.5	Varro clay loam	1,340	.2
Gladewater clay, frequently flooded	20,990	3.0	Vesey fine sandy loam, 3 to 8 percent slopes	5,330	.8
Hapludalfs, loamy, 0 to 2 percent slopes	1,960	.3	Vesey fine sandy loam, 8 to 20 percent slopes	3,790	.6
Houston Black clay, 1 to 3 percent slopes	15,650	2.4	Waskom loam	2,000	.3
Kaufman clay	4,610	.6	Whakana loam, 3 to 8 percent slopes	4,620	.7
Kaufman clay, frequently flooded	34,704	5.2	Whakana-Elysian complex, 0 to 1 percent slopes	9,040	1.4
Kenney loamy fine sand, 2 to 8 percent slopes	1,860	.3	Woodtell fine sandy loam, 1 to 5 percent slopes	61,610	9.3
Kiomatia loamy fine sand, frequently flooded	2,620	.4	Woodtell fine sandy loam, 5 to 12 percent slopes	36,560	5.5
Kullit-Addielou complex, 1 to 3 percent slopes	43,950	6.6	Wrightsville-Rodessa complex	105,830	15.9
Mabank fine sandy loam, 0 to 1 percent slopes	16,930	2.6	Water area	1,216	.2
McKamie loam, 1 to 5 percent slopes	2,900	.4			
McKamie loam, 5 to 12 percent slopes	7,690	1.2	Total	662,400	100.0

sandy clay loam mottled with yellowish red. The next layer is 12 inches of mottled yellowish-brown, gray, and yellowish-red sandy clay loam that contains vertical streaks and pockets of uncoated sand. Below this to a depth of 90 inches is gray clay that is coarsely mottled with red and yellowish brown. It contains vertical streaks of uncoated sand.

Addielou soils are moderately well drained. Permeability is moderately slow, and available water capacity is medium. These soils have a high potential as pastureland and a medium potential as cropland and woodland.

In Red River County, Addielou soils are mapped only in complexes with Freestone and Kullit soils.

Representative profile of an Addielou fine sandy loam in an area of Kullit-Addielou complex, 1 to 3 percent slopes, on a mound 7 miles north of the courthouse in Clarksville on Texas Highway No. 37, 1 mile east of county road, and 50 feet south of road, in pine plantation:

A1—0 to 8 inches, brown (10YR 5/3) fine sandy loam; weak, fine, granular structure; slightly hard, very friable; common tree roots; medium acid; gradual, smooth boundary.

A2—8 to 28 inches, light yellowish-brown (10YR 6/4) fine sandy loam; weak, fine, subangular blocky structure; slighty hard, very friable; few fine roots; few fine and very fine pores; few worm channels; slightly acid; clear, irregular boundary.

B21t—28 to 48 inches, yellowish brown (10YR 5/6) sandy clay loam; few, fine, prominent, yellowish-red (5YR 4/8) mottles; moderate, medium, subangular blocky structure; hard, friable; patchy clay films; very strongly acid; gradual, smooth boundary.

B22t—48 to 60 inches, mottled yellowish-brown (10YR 5/6), gray (10YR 6/1), and yellowish-red (5YR 4/8) sandy clay loam; moderate, medium, subangular blocky structure; hard, friable; continuous clay films; vertical streaks and small pockets of light-gray (10YR 7/2) uncoated sand; few black concretions; very strongly acid; gradual, smooth boundary.

B23t&A'2—60 to 90 inches, gray (10YR 6/1) clay; many, medium, coarse, prominent, red (2.5YR 4/8) mottles and few, distinct, yellowish-brown (10YR 5/4) mottles; moderate, coarse, blocky structure; extremely hard, very firm, plastic; continuous clay films; 5 to 10 percent vertical streaks of light-gray (10YR 7/1) uncoated sand; very strongly acid.

The solum ranges from 60 inches to about 100 inches in thickness.

The A horizon ranges from 22 to 36 inches in thickness. It is medium acid to neutral. The A1 horizon is very dark grayish brown, dark grayish brown, or brown. The A2 horizon is light yellowish brown or pale brown.

The B21t and B22t horizons range from 20 to 40 inches in thickness. They are yellowish brown, strong brown, or reddish yellow and have few to common mottles of red, yellowish red, and gray. Mottles with chroma of 2 or less occur below a depth of 30 inches. These horizons are sandy clay loam, clay loam, or loam that is 18 to 30 percent clay. They are very strongly acid to medium acid.

The B23t&A'2 horizon is gray, red, or strong brown or is mottled red and gray and has few to common mottles of yellowish brown. It is clay or clay loam that is 35 to 50 percent clay. The horizon is 5 to 10 percent vertical streaks and pockets of uncoated sand and silt. It is very strongly acid or strongly acid.

Annona Series

The Annona series consists of deep, gently sloping, loamy, acid soils on uplands. These soils are on stream divides. They formed in clayey and loamy sediment.

In a representative profile the surface layer is loam

about 10 inches thick. The upper 5 inches is dark grayish brown, and the lower 5 inches is light yellowish brown. The next layer is 30 inches of mottled clay. It is red in the upper part and gray in the lower part. The next layer is 19 inches of yellowish-brown clay. Below this to a depth of 95 inches is mottled yellowish-brown and gray clay.

Annona soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. These soils have a high potential as pastureland and a medium potential as woodland and cropland.

Representative profile of an Annona loam in an intermound area of Annona-Freestone complex, 1 to 3 percent slopes, 10 miles north of Clarksville on Texas Highway No. 37, 3 miles west of Farm Road 2118, 2.5 miles west on International Paper Company Road No. 10 to Company Road No. 15, 100 feet northeast of road intersection, in woodland:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, very fine, granular structure; slightly hard, very friable; common roots; few krotovinas; slightly acid; clear, wavy boundary.

A2—5 to 10 inches, light yellowish-brown (10YR 6/4) loam; few, fine, faint, brownish-yellow (10YR 6/6) and light brownish-gray (10YR 6/2) mottles; weak, fine, subangular blocky structure; slightly hard, very friable; strongly acid; clear, wavy boundary.

B21t—10 to 18 inches, dark-red (2.5YR 3/6) clay; many, medium, prominent, gray (10YR 6/1) mottles and few, fine, prominent, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, subangular blocky structure; extremely hard, very firm; few fine roots; common pressure faces; few patchy clay films; few quartz pebbles as much as 1 inch in diameter; very strongly acid; gradual, wavy boundary.

B22t—18 to 31 inches, gray (10YR 6/1) clay; common, medium, prominent, dark-red (2.5YR 3/6) mottles and common, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine, blocky structure; extremely hard, very firm; few fine roots; common pressure faces; few clay films; strongly acid; gradual, wavy boundary.

B23t—31 to 40 inches, gray (10YR 6/1) clay; common, medium, prominent, yellowish-red (5YR 4/8) mottles; moderate, fine, blocky structure; extremely hard, very firm; few fine roots between peds; common pressure faces; few thin clay films; cracks between a few peds contain coatings of pale-brown (10YR 6/3) uncoated sand 1 to 3 millimeters thick; strongly acid; gradual, wavy boundary.

B24t—40 to 59 inches, yellowish-brown (10YR 5/4) clay; many, fine and medium, distinct, gray (10YR 6/1) mottles; few streaks of very dark gray (5YR 3/1); moderate, medium, blocky structure; extremely hard, very firm; few, fine, pitted concretions of calcium carbonate; few fine roots between peds; few pressure faces; few cracks filled with pale-brown (10YR 6/3) uncoated sand 2 to 4 millimeters thick; medium acid; gradual, wavy boundary.

B25t—59 to 95 inches, mottled yellowish-brown (10YR 5/6) and gray (10YR 6/1) clay; moderate, coarse, blocky structure; extremely hard, very firm; continuous clay films; many slickensides; common, medium and fine, soft, dark deposits; few, fine, pitted concretions of calcium carbonate; small pockets of white neutral salts; few peds coated with black (N 2/0); mildly alkaline.

The solum ranges from 60 inches to about 100 inches in thickness.

The A horizon ranges from 6 to 12 inches in thickness. It is very strongly acid to slightly acid. The A1 horizon is dark grayish brown, very dark grayish brown, dark gray, dark yellowish brown, brown, yellowish brown, or light yellowish brown. The A2 horizon is pale brown, light yellowish brown, gray, or light gray.

The B21t horizon is dark red, red, yellowish red, or reddish yellow and has few to many mottles of gray, dark yellowish brown, and yellowish brown. It is clay loam or clay that is 35 to 60 percent clay. This horizon is strongly acid to very strongly acid. The B22t and B23t horizons are mottled gray, red, dark-red, yellowish-red, yellowish-brown, light olive-brown, or olive-yellow clay or clay loam. They are strongly acid to medium acid. The B24t and B25t horizons are mottled red, gray, yellowish-red, yellowish-brown, light olive-brown, and olive-yellow clay or clay loam. They are medium acid to moderately alkaline.

Annona-Freestone complex, 1 to 3 percent slopes (AfB).—This complex is about 63 percent Annona loam, 18 percent Freestone fine sandy loam, and 19 percent other soils. It is in most wooded areas in the county on broad ridgetops or along gently sloping stream divides. Areas are weakly convex, are irregular in shape, and are 75 to 300 acres.

This complex is characterized by areas of Annona soils from which circular mounds of Freestone soils protrude in a random pattern. The mounds are 35 to 60 feet in diameter, are 100 to 200 feet apart, and make up about 30 percent of a typical mapped area. The less extensive soils occur in patterns too intricate to separate at the scale used in mapping. The intermound areas of Annona loam serve as tenuous drainageways without channels.

The Freestone soil has a surface layer of fine sandy loam about 16 inches thick. It is dark grayish brown in the upper 6 inches and light yellowish brown in the lower 10 inches. The next layer is sandy clay loam 16 inches thick. It is reddish yellow mottled with red in the upper 8 inches, and it is yellowish brown and has cracks and pockets of uncoated sand in the lower 8 inches. The next layer is 24 inches of mottled gray and red clay. Below this to a depth of 65 inches is gray clay mottled with brown.

Included with this complex in mapping are Wrightsville, Rodessa, and Woodtell soils. Wrightsville soils are in poorly drained spots within areas of Annona soils and are less than 5 acres. Rodessa soils are at the top of some mounds. Woodtell soils are on narrow ridges. They are less than 8 acres and make up less than 10 percent of any mapped area.

Runoff is slow. The hazard of erosion is moderate.

About 30 percent of the acreage is used for tame pasture. About 66 percent is in native timber that consists of a mixture of hardwoods and a few scattered pines. About 4 percent is cultivated. Both soils in capability unit IIIe–1; Annona part in pasture and hayland group 8A, Freestone part in pasture and hayland group 8C; Annona part in woodland suitability group 4c2, Freestone part in woodland suitability group 3w8.

Austin Series

The Austin series consists of moderately deep, gently sloping, clayey, alkaline soils on uplands. These soils formed in interbedded clayey and chalky material.

In a representative profile the surface layer is very dark grayish-brown silty clay about 11 inches thick. The next layer is 26 inches of grayish-brown silty clay

mottled with very dark grayish brown in the upper 9 inches and light olive brown in the lower 17 inches. The underlying material to a depth of 50 inches is interbedded light-gray silty clay and chalk.

Austin soils are well drained. Permeability is moderately slow, and available water capacity is high. These soils have a high potential as pastureland, a medium potential as cropland, and a low potential as woodland.

Representative profile of Austin silty clay, 1 to 3 percent slopes, 1 mile north of Clarksville to dam of site No. 1 of Langford Creek Watershed, 0.6 mile north of west end of dam on access road to corner of fence, 1,100 feet northwest along fence, 5 feet north of fence, in pasture:

A1—0 to 11 inches, very dark grayish-brown (10YR 3/2) silty clay; moderate, fine, granular structure; hard, firm; many fine roots; grayish-brown (2.5Y 5/2) krotovinas; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B21—11 to 20 inches, grayish-brown (2.5Y 5/2) silty clay; many, fine, distinct, very dark grayish-brown (10YR 3/2) mottles; moderate, fine, subangular blocky structure; hard, firm; few roots; few masses and concretions of calcium carbonate; few very dark grayish-brown (10YR 3/2) krotovinas; calcareous; moderately alkaline; gradual, wavy boundary.

B22—20 to 37 inches, grayish-brown (2.5Y 5/2) silty clay; common, fine, distinct, light olive-brown (2.5Y 5/4) mottles; moderate, fine, subangular blocky structure; hard, friable; many masses and few concretions of calcium carbonate; few dark grayish-brown (10YR 4/2) krotovinas; calcareous; moderately alkaline; gradual, wavy boundary.

C—37 to 50 inches, light-gray (2.5Y 7/2) silty clay; common, fine, distinct, yellow (2.5Y 7/6) mottles; massive; hard, friable; interbedded with strata of light-gray (2.5Y 7/2) chalk that can be cut with spade; calcareous; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness but averages about 30 inches. It is calcareous throughout. Few chalk fragments occur on the surface and in some profiles.

The A horizon ranges from 10 to 20 inches in thickness. It is dark brown, very dark grayish brown, and very dark brown.

The B horizon ranges from 10 to 30 inches in thickness. It is light brownish gray, grayish brown, dark grayish brown, brown, light olive brown, and olive brown. It is silty clay loam, clay loam, silty clay, and clay. It is 35 to 50 percent clay.

The C horizon is typically partly weathered chalk, but some pedons are underlain by calcareous silty material.

Austin silty clay, 1 to 3 percent slopes (AuB).—This gently sloping soil is on ridgetops. Areas are convex, irregular in shape, and are 15 to 200 acres.

Included with this soil in mapping are areas of Cuthand soils 2 to 5 acres in size where slopes are steep. Also included are small areas of Houston Black soils that are less sloping than this soil and small areas of Bryarly soils on side slopes. The included soils make up less than 10 percent of mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 60 percent of the acreage is used for pasture, and 40 percent is cultivated. Capability unit IIIe–3; pasture and hayland group 7C; woodland suitability group not assigned.

Bernaldo Series

The Bernaldo series consists of deep, gently sloping, loamy, acid soils on uplands. These soils formed in loamy sediment.

In a representative profile the surface layer is brown fine sandy loam about 10 inches thick. The next layer is 40 inches of yellowish-brown sandy clay loam mottled with red and light brownish gray in the lower part. Below this to a depth of 93 inches is yellowish-brown clay loam mottled with yellowish red and gray.

Bernaldo soils are well drained. Permeability is moderate, and available water capacity is high. These soils have a high potential as pastureland, woodland, and cropland.

Representative profile of Bernaldo fine sandy loam in an area of Bernaldo-Elysian complex, 1 to 3 percent slopes, 3.5 miles west of Avery on county road to Park's Ranch headquarters, 0.75 mile south on field road in pasture, 125 feet northwest of fence corner, and 500 feet southwest of cemetery:

A1—0 to 10 inches, brown (10YR 5/3) fine sandy loam; weak, very fine, granular structure; soft, very friable; common fine roots; slightly acid; clear, smooth boundary.

B21t—10 to 19 inches, yellowish-brown (10YR 5/6) sandy clay loam; weak, medium, subangular blocky structure; hard, friable; few fine pores; many fibrous roots; few krotovinas filled with brown (10YR 5/3); patchy clay films 1 unit darker in value; slightly acid; gradual, smooth boundary.

B22t—19 to 32 inches, yellowish-brown (10YR 5/6) sandy clay loam; many, fine and medium, yellowish-red (5YR 5/8) mottles; weak, medium, subangular blocky structure; hard, friable; patchy clay films 1 unit darker in value; very strongly acid; gradual, wavy boundary.

B23t—32 to 50 inches, yellowish-brown (10YR 5/6) sandy clay loam; common, fine and medium, red (2.5YR 4/6) mottles and few, fine, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure; patchy clay films 1 unit darker in value; gray (10YR 6/1) mostly on surface of peds and in channels; very strongly acid; gradual, smooth boundary.

B24t—50 to 93 inches, yellowish-brown (10YR 5/8) clay loam; common, fine and medium, distinct, yellowish-red (5YR 5/6) and gray (10YR 6/1) mottles; moderate, coarse, blocky structure; hard, friable; gray (10YR 6/1) surrounds yellowish brown (10YR 5/8); 5 to 10 percent tongues of uncoated sand and silt; very strongly acid.

The solum ranges from 60 inches to about 100 inches in thickness.

The A1 horizon ranges from 6 to 16 inches in thickness. It is very dark grayish-brown, dark grayish-brown, brown, dark yellowish-brown, or pale-brown fine sandy loam and loamy very fine sand. It is medium acid to slightly acid. The A2 horizon ranges from 0 to 11 inches in thickness. It is light yellowish-brown, yellowish-brown, brown, or pale-brown fine sandy loam or loamy very fine sand. It is medium acid to slightly acid. The A1 and A2 horizons combined average 8 to 18 inches in thickness.

The B21t horizon ranges from 5 to 19 inches in thickness. It is yellowish-brown, brownish-yellow, or strong-brown sandy clay loam or clay loam that is 20 to 35 percent clay. Few to common yellowish-red mottles are in a few places. It is very strongly acid to slightly acid. The lower part of the Bt horizon is yellowish-brown sandy clay loam or clay loam and has few to many mottles of yellowish red, red, and dark red. At depths greater than 30 inches, it has few to many mottles of light gray or light brownish gray. It is very strongly acid to medium acid.

Bernaldo-Elysian complex, 1 to 3 percent slopes (BeB).—This complex is about 65 percent Bernaldo fine sandy loam, 25 percent Elysian loam, and 10 percent other soils. It is on interstream divides. Areas are irregular in shape, weakly dissected, and weakly convex. They are 10 to 300 acres in size but average about 40 acres.

This complex is characterized by areas of Bernaldo fine sandy loam from which circular mounds protrude in a random pattern. The mounds are so small and the soil pattern so intricate that it was not practical to separate the soils at the scale used in mapping. The mounds are 40 to 60 feet in diameter, 22 to 36 inches high, and 50 to 75 feet apart.

The Elysian soil has a surface layer of brown fine sandy loam about 6 inches thick. The next layer is 16 inches of light yellowish-brown fine sandy loam. The next layer is 37 inches of strong-brown loam that contains vertical streaks and pockets of pale-brown fine sandy loam in the upper part. The next layer is 13 inches of yellowish-brown loam mottled with yellowish red. Below this to a depth of 95 inches is strong-brown clay loam mottled with yellowish red. It is 2 to 3 percent uncoated sand.

Included with this complex in mapping are areas of Kullit soils, 3 to 6 acres in size, that make up about 5 percent of mapped areas. Also included are few areas of Woodtell soils 3 to 5 acres in size. They are on short, steep slopes and make up 5 to 10 percent of some mapped areas.

Runoff is slow. The hazard of erosion is moderate.

About 65 percent of the acreage is used for pasture, 8 percent is cultivated, and 27 percent is wooded (fig. 3). Capability unit IIe–1; pasture and hayland group 8C; woodland suitability group 2o7.

Bryarly Series

The Bryarly series consists of deep, gently sloping, loamy, acid soils on uplands. These soils formed in calcareous, clayey marine sediment. They are on side slopes along drainageways.

In a representative profile the surface layer is very dark grayish-brown clay loam about 3 inches thick. The next layer is 43 inches of mottled red and gray clay. The underlying material to a depth of 81 inches is light olive-brown calcareous clay mottled with red and gray. It contains concretions of calcium carbonate.

Bryarly soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and a low potential as cropland and woodland.

Representative profile of Bryarly clay loam, 1 to 5

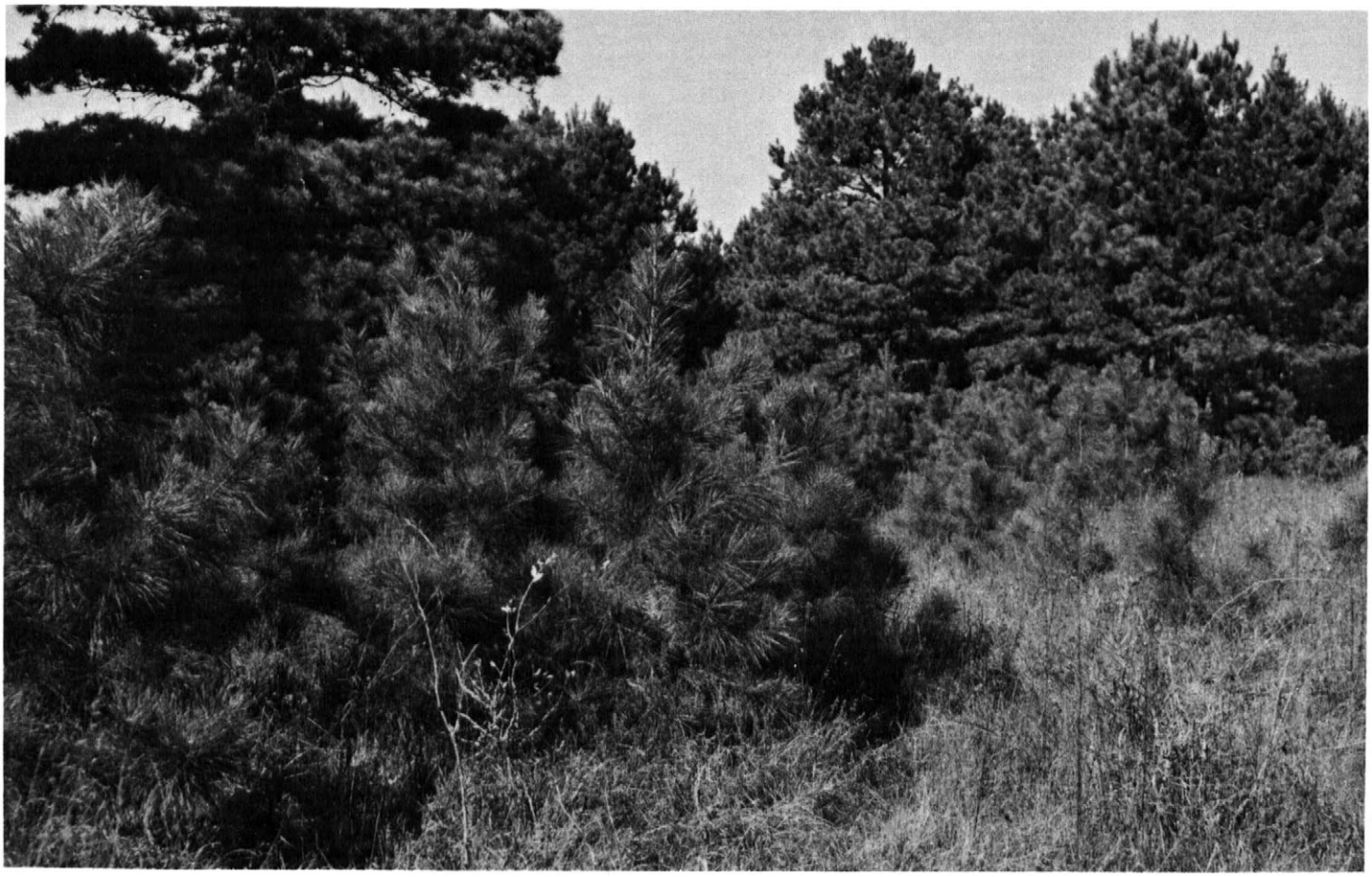


Figure 3.—**Natural reseeding of loblolly pine on Bernaldo-Elysian complex, 1 to 3 percent slopes.**

percent slopes, 1.2 miles south of Boxelder on county road, 0.5 mile east and 1 mile south on county road, 1.3 miles south on private road, 100 feet east of private road:

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) clay loam; moderate, very fine, granular structure; very hard, firm; few roots; medium acid; gradual, smooth boundary.

B21t—3 to 18 inches, red (2.5YR 4/6) clay; common, fine and medium, prominent, gray (10YR 6/1) mottles; moderate, fine, blocky structure; extremely hard, very firm; few roots; continuous clay films or pressure faces; very strongly acid; gradual, smooth boundary.

B22t—18 to 46 inches, gray (10YR 6/1) clay; many, fine and medium, prominent, red (2.5YR 4/6) mottles and common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, blocky structure; extremely hard, very firm; continuous clay films or pressure faces; medium acid; gradual, smooth boundary.

B3ca—46 to 70 inches, light olive-brown (2.5Y 5/4) clay; few, fine, prominent, red and gray mottles; weak, subangular blocky structure; extremely hard, very firm; few shiny pressure faces; 5 to 10 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

Cca—70 to 81 inches, light olive-brown (2.5Y 5/4) clay; few, fine and medium, distinct, gray (5Y 6/1) mottles; massive; extremely hard, very firm; few concretions and masses of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 inches to more than 80 inches in thickness.

The A horizon is very dark brown, dark grayish brown, very dark grayish brown, dark yellowish brown, or dark brown. It is mottled with very dark grayish brown, pale brown, dark brown, or strong brown in some profiles. It is very strongly acid to slightly acid. The boundary is clear or gradual.

The B21t horizon is red, yellowish red, or reddish brown. It is mottled with gray, yellowish brown, grayish brown, light brownish gray, brown, or dark grayish brown in most profiles. It is 45 to 60 percent clay and is very strongly acid or strongly acid. The B22t horizon is similar in clay content to the B21t horizon, but it is gray or light brownish gray and is mottled with red or yellowish brown. The B3ca horizon is light olive brown, gray, or olive and is mottled with red, gray, olive, and brown. It is clay or shaly clay. It is mildly alkaline or moderately alkaline, is calcareous, and contains few to common soft masses and concretions of calcium carbonate.

The Cca horizon is light olive brown, gray, pale yellow, or olive and is mottled in shades of red, gray, olive, or brown. It is clay or shaly clay and contains few to common soft masses and hard concretions of calcium carbonate.

Bryarly clay loam, 1 to 5 percent slopes (BrC).—This soil is in long, narrow areas on side slopes along streams. Slopes are weakly convex and average about 4 percent. Areas are 8 to 100 acres in size.

Included with this soil in mapping are areas of Woodtell soils 5 to 8 acres in size. These soils are on the upper part of the side slopes. They make up 10 to 15 percent of some mapped areas. A few small areas of Bernaldo soils are also included. They are on the higher positions on the landscape.

Runoff is medium. The hazard of erosion is moderate.

About 40 percent of the acreage is wooded, and about 60 percent is used for pasture. Capability unit IVe–1; pasture and hayland group 8A; woodland suitability group 5c2.

Burleson Series

The Burleson series consists of deep, nearly level to gently sloping, clayey, acid soils on uplands, ridgetops, and gentle side slopes. These soils formed in alkaline, clayey material.

In a representative profile the surface layer is clay 56 inches thick. The upper 24 inches is very dark gray, and the lower 32 inches is dark gray. The next layer is 12 inches of dark-gray clay. Below this to a depth of 87 inches is mottled yellowish-brown, gray, and light-gray clay that contains fragments of shale.

Burleson soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils have a high potential as pastureland and cropland and a low potential as woodland.

Representative profile of Burleson clay, 1 to 3 percent slopes, 12 miles south of junction, in Clarksville, of Texas Highway No. 37 and U.S. Highway No. 82, 1 mile west on county road, 1 mile north on county road, 600 feet east of road, and 200 feet east of old house:

Ap—0 to 5 inches, very dark gray (10YR 3/1) clay; few, fine, dark yellowish-brown (10YR 4/4) specks; weak, fine, subangular blocky structure and very fine, granular structure; extremely hard, very firm; medium acid; gradual, smooth boundary.

A12—5 to 24 inches, very dark gray (10YR 3/1) clay; few, fine, faint, brown (10YR 5/3) mottles; moderate, very fine, blocky structure; extremely hard, very firm; slightly acid; gradual, smooth boundary.

A13—24 to 56 inches, dark-gray (10YR 4/1) clay; moderate, very fine, blocky structure; extremely hard; intersecting slickensides about 4 inches across; few siliceous pebbles; mildly alkaline; gradual, wavy boundary.

AC1—56 to 68 inches, dark-gray (10YR 4/1) clay; common, large, distinct, olive-brown (2.5Y 4/4) mottles; moderate, coarse, blocky structure; extremely hard, very firm; fewer slickensides than in horizon above; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

AC2—68 to 87 inches, mottled yellowish-brown (10YR 5/8), gray (10YR 5/1), and light-gray (10YR 6/1) clay; moderate, fine, blocky structure; extremely firm; calcareous; moderately alkaline; contains about 25 percent moderate, medium, platy, partly weathered shale; very hard, very firm.

The solum ranges from 36 to 90 inches in thickness. When dry it has cracks that range from 0.4 inch to 1.5 inches in width at a depth of 20 inches. Intersecting slickensides begin at a depth of 20 to 30 inches.

The A horizon varies in thickness because of microrelief. It averages about 20 inches in thickness, but ranges from 8 inches on microknolls to 50 inches in microdepressions. It is very dark gray, dark gray, or black. It is medium acid to moderately alkaline, and the matrix is noncalcareous. The AC horizon is gray, light gray, yellowish brown, or dark gray and has few to common, faint to distinct mottles of brown, olive, and yellow. It is mildly alkaline to moderately alkaline.

Burleson clay, 0 to 1 percent slopes (BuA).—This nearly level soil is on ridgetops and on flats at the heads of drainageways. Areas are 7 to 360 acres but average about 80 acres.

The surface layer is very dark gray, acid clay about 31 inches thick. The next layer is about 20 inches of dark-gray clay mottled with yellowish brown. Below this is about 9 inches of stratified, yellowish-brown and grayish-brown, alkaline shale.

Included with this soil in mapping are areas of Burle-

son clay, 1 to 3 percent slopes. These areas are 4 to 15 acres and make up 10 to 20 percent of some mapped areas. Also included are areas of Deport soils, 3 to 10 acres in size, that make up 5 to 15 percent of some mapped areas and a few areas of Houston Black soils, 5 to 10 acres in size, that make up 5 to 15 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 35 percent of the acreage is cultivated. About 65 percent is used for hay and pasture. Capability unit IIw–3; pasture and hayland group 7A; woodland suitability group not assigned.

Burleson clay, 1 to 3 percent slopes (BuB).—This gently sloping soil is on broad, low ridgetops and gentle side slopes. Areas are 15 to 2,000 acres but average about 150 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Deport soils, 3 to 8 acres in size, that make up 5 to 10 percent of the mapped areas. Also included are areas of Mabank soils that occupy lower positions; they are 3 to 5 acres and make up 5 to 8 percent of some mapped areas. In a few mapped areas, areas of Houston Black soils, 5 to 8 acres in size, are on ridgetops.

Runoff is medium. The hazard of erosion is moderate.

About 70 percent of the acreage is cultivated. About 30 percent is used for pasture and hay. Capability unit IIe–3; pasture and hayland group 7A; woodland suitability group not assigned.

Crockett Series

The Crockett series consists of deep, gently sloping, loamy, acid soils on uplands. These soils formed in alkaline, clayey or shaly material interbedded with sandier material. They are on stream divides.

In a representative profile the surface layer is loam about 10 inches thick. It is dark grayish brown in the upper 7 inches and dark brown in the lower 3 inches. The next layer is 13 inches of dark reddish-brown clay mottled with gray. The next layer is 27 inches of yellowish-brown clay mottled with dark reddish brown, yellowish brown, and gray. The underlying material to a depth of 70 inches is partly weathered shale.

Crockett soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils have a high potential as pastureland, a medium potential as cropland, and a low potential as woodland.

Representative profile of Crockett loam, 1 to 3 percent slopes, 6.2 miles southeast of Boxelder on Farm Road No. 44 to Shawnee Ranch headquarters, 300 yards south on Farm Road No. 46, and 75 feet east of road:

A11—0 to 7 inches, dark grayish-brown (10YR 4/2) loam; massive; hard, friable; many fine roots; many fine and medium pores; few, fine, strong-brown mottles that are associated with black or dark-brown, semi-indurated, shotlike concretions of iron; few water-worn pebbles as much as 2 inches in diameter; medium acid; clear, smooth boundary.

A12—7 to 10 inches, dark-brown (10YR 4/3) loam; weak, very fine, granular structure; very hard, friable; many roots; many fine pores; medium acid; abrupt, wavy boundary.

B21t—10 to 23 inches, dark reddish-brown (5YR 3/4) clay; common, fine, distinct, gray (10YR 5/1) mottles; moderate, coarse, blocky structure; extremely hard, very firm, plastic; few fine roots; common clay films; slightly acid; gradual, smooth boundary.

B22t—23 to 34 inches, yellowish-brown (10YR 5/4) clay; few, fine, distinct, dark reddish-brown (5YR 3/4) mottles; moderate, coarse, blocky structure; extremely hard, very firm, plastic; few fine roots; common clay films; mildly alkaline; gradual, smooth boundary.

B23t—34 to 50 inches, yellowish-brown (10YR 5/4) clay; few, fine, distinct, yellowish-brown (10YR 5/6) mottles and few, fine, faint, gray (10YR 5/1) mottles; weak, coarse, blocky structure; extremely hard, very firm, plastic; few clay films; few, fine, dark-brown concretions; mildly alkaline; gradual boundary.

C—50 to 70 inches, mottled, gray (5Y 6/1) and yellowish-brown (10YR 5/6), thinly bedded, partly weathered shale; few pockets of white (10YR 8/2) neutral salts; calcareous; moderately alkaline.

The solum ranges from 40 to 55 inches in thickness.

The A horizon ranges from 5 to 10 inches in thickness. It is dark grayish brown, brown, or light yellowish brown. It is medium acid to neutral.

The B21t horizon is brown, dark reddish-brown, dark-brown, or reddish-brown clay or sandy clay. In most profiles it is mottled with gray, yellowish brown, olive, or dark red. It is slightly acid to mildly alkaline. The B22t and B23t horizons are dark yellowish brown, yellowish brown, olive, or olive brown. They are mottled with dark reddish brown, yellowish brown, gray, or olive. They are medium acid to mildly alkaline.

The C horizon is gray, yellow, and yellowish-brown, thinly bedded shaly clay or clay. It is mildly alkaline to moderately alkaline.

Crockett loam, 1 to 3 percent slopes (CrB).—This gently sloping soil is on broad, low ridgetops and gentle side slopes, mainly in areas of prairie. Areas range from 10 to 1,500 acres in size but commonly are 100 to 300 acres. They are irregular in shape.

Included with this soil in mapping are areas of Mabank soils on foot slopes. These areas are 2 to 5 acres and make up less than 5 percent of mapped areas. Also included are areas of Woodtell soils, 2 to 5 acres in size, that make up less than 5 percent of some mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 70 percent of the acreage is used for pasture. About 30 percent is cultivated. Capability unit IIIe–1; pasture and hayland group 8A; woodland suitability group not assigned.

Cuthand Series

The Cuthand series consists of moderately deep, gently sloping to sloping, loamy, alkaline soils on uplands. These soils formed in material weathered from stratified calcareous shale. They are eroded.

In a representative profile the surface layer is dark grayish-brown loam about 10 inches thick. The next layer is 9 inches of pale-brown loam. The next layer is 6 inches of pale-olive loam. The next layer is 20 inches of light brownish-gray shale. The underlying material extends to a depth of 50 inches. The upper 20 inches is light brownish-gray fissile shale, and the lower 15 inches is massive gray shale.

Cuthand soils are well drained. Permeability is moderate, and available water capacity is medium. These soils have a medium potential as pastureland and

a low potential as cropland and woodland.

Representative profile of Cuthand loam, 4 to 8 percent slopes, eroded, 1.5 miles east of Clarksville on U.S. Highway No. 82, 7 miles east on Farm Road No. 114, 2.9 miles north on Farm Road No. 1158, 0.6 mile east on county road, and 30 feet south of road:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, subangular blocky structure and moderate, very fine, granular structure; hard, friable; many fibrous roots; calcareous; moderately alkaline; gradual, smooth boundary.

B21—10 to 19 inches, pale-brown (10YR 6/3) loam; moderate, fine, subangular blocky structure and moderate, very fine, granular structure; hard, friable; common fine roots; calcareous; moderately alkaline; gradual, smooth boundary.

B22—19 to 25 inches, pale-olive (5Y 6/3) loam; few, fine, distinct, yellow (2.5Y 7/6) mottles; moderate, very fine, subangular blocky structure; hard, friable; few fine roots; calcareous; moderately alkaline; gradual, wavy boundary.

C1ca—25 to 45 inches, light brownish-gray (2.5Y 6/2) fissile shale, coarsely mottled with light yellowish brown (2.5Y 6/4); shale is bedded parting into plates 2 to 5 inches thick and 5 to 18 inches along the horizontal axis; few roots along fractured faces; few, soft coatings of calcium carbonate on faces of shale fragments and partings; calcareous; moderately alkaline; clear, wavy boundary.

C2—45 to 50 inches, gray (5Y 5/1) shale; massive; difficult to dig with spade below a depth of 50 inches; calcareous; moderately alkaline.

The solum ranges from 25 to 40 inches in thickness. The A horizon is dark gray, very dark gray, very dark grayish brown, or dark grayish brown.

The B2 horizon is pale-brown, pale-yellow, light olive-gray, brown, light yellowish-brown, or pale-olive loam or silt loam. In most profiles it is mottled with shades of brown and yellow.

The Cca horizon is light brownish-gray, brownish-gray, gray, or light olive-brown, fractured, calcareous shale. In some profiles there are thin layers of clay loam or loam between the plates of shale. The C horizon is gray or light-gray massive shale.

Cuthand loam, 4 to 8 percent slopes, eroded (CuD2).—This soil is on side slopes. Slopes average about 5 percent. Areas are 6 to 200 acres and are irregular in shape. Most areas are eroded and have gullies 6 to 60 feet across at the top, 1 to 2 feet deep, and 75 to 125 feet apart.

Included with this soil in mapping are areas of soils, 2 to 5 acres in size, that have a thin solum, are calcareous, and are underlain by shale. These areas make up about 2 to 10 percent of mapped areas. Also included are areas of Austin soils, 5 to 10 acres in size, that make up 3 to 15 percent of mapped areas.

Runoff is medium. The hazard of erosion is severe.

About 85 percent of the acreage is used for pasture, and about 15 percent is used for cropland. Capability unit VIe–2; pasture and hayland group 7D; woodland suitability group not assigned.

Deport Series

The Deport series consists of deep, gently sloping, clayey, acid soils on uplands. These soils formed in shale. They are on side slopes.

In a representative profile the surface layer is very dark gray clay about 6 inches thick. The next layer is 31 inches of dark-gray and gray clay mottled with dark grayish brown and yellowish brown. The next layer is 20 inches of olive-brown clay mottled with gray and yellowish brown. The underlying material to a depth of 68 inches is shale.

Deport soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. These soils have a medium to high potential as pastureland, a medium potential as cropland, and a low potential as woodland.

Representative profile of Deport clay, 1 to 3 percent slopes, 12 miles southwest of Clarksville, about 100 feet southwest of intersection of Texas Highway No. 37 and county road:

Ap—0 to 6 inches, very dark gray (10YR 3/1) clay; few, fine, faint, grayish-brown mottles; moderate, fine, subangular blocky structure; extremely hard, very firm; many fine roots; few quartz pebbles; medium acid; gradual, smooth boundary.

AC1g—6 to 30 inches, dark gray (10YR 4/1) clay; few, fine, faint, dark grayish-brown mottles and common, fine, distinct, yellowish-brown mottles; moderate, fine, subangular blocky structure; extremely hard, very firm; few fine roots; few intersecting slickensides 2 to 4 inches across; many pressure faces; few vertical cracks about 1 centimeter wide filled with dark gray (10YR 4/1); few quartz pebbles; slightly acid; gradual, wavy boundary.

AC2g—30 to 37 inches, gray (10YR 5/1) clay; few, fine, faint; yellowish-brown (10YR 5/4) and dark grayish-brown (10YR 4/2) mottles; moderate, fine, blocky structure; extremely hard, very firm; few roots; common intersecting slickensides 2 to 6 inches across; few streaks or cracks about 1 centimeter wide filled with dark gray (10YR 4/1); few quartz pebbles; mildly alkaline; gradual, wavy boundary.

AC3g—37 to 57 inches, olive-brown (2.5Y 4/4) clay; common, medium, faint, yellowish-brown (10YR 5/8) mottles and few, fine, distinct, gray mottles; moderate, fine, blocky structure; extremely hard, very firm; common intersecting slickensides 1 to 5 inches across; vertical cracks about 1 centimeter wide filled with dark gray (10YR 4/1) and gray (10YR 5/1); about 20 percent fragments of shale in lower part; calcareous; moderately alkaline; gradual, wavy boundary.

C—57 to 68 inches, stratified, brownish-yellow (10YR 6/8) and light brownish-gray (2.5Y 6/2 shale; moderate, medium, platy structure; extremely hard, very firm; soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 40 inches to about 65 inches in thickness. Few to common intersecting slickensides 2 to 8 inches wide begin at depths ranging from 12 to 20 inches. Cycles of microdepressions and microknolls are repeated every 4 to 10 feet. Depth to moist values greater than 3.5 range from 0 to 5 inches in microknolls to 6 to 11 inches in microdepressions. Depth to the C horizon ranges from 40 to 50 inches in microknolls to 50 to 65 inches in microdepressions.

The A horizon is dark gray, very dark gray, or gray. It is medium acid to mildly alkaline. The AC1 horizon is dark gray or gray and is mottled with gray, brown, olive, or yellow. It is medium acid to mildly alkaline. The AC2g and AC3g horizons are gray, grayish brown, light olive brown, brown, light brownish gray, olive brown, or light gray. They are mottled with gray, brown, olive, or yellow and are slightly acid to moderately alkaline. A few profiles are calcareous below a depth of about 30 inches.

The C horizon is light brownish gray, brownish yellow, light yellowish brown, or light olive gray and has many mottles of the same colors. It is noncalcareous or calcareous shale or shaly clay. It is moderately alkaline and contains a few soft masses of calcium carbonate.

Deport clay, 1 to 3 percent slopes (DaB).—This gently sloping soil is on convex side slopes. Areas are long and narrow. Slopes average about 2 percent. Areas are 10 to 100 acres but average about 50 acres.

Included with this soil in mapping are areas of Burleson soils, 5 to 10 acres in size. They are on gently sloping ridges and make up 10 to 20 percent of mapped areas. Also included are areas of Ellis soils 3 to 8 acres in size. They are on steeper spots and make up 5 to 10 percent of some mapped areas. There are also a few areas of Ferris soils, 5 to 10 acres in size, that make up 10 to 15 percent of some mapped areas. The included soils make up less than 25 percent of any mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 75 percent of the acreage is used for pasture, about 20 percent is wooded, and about 5 percent is cultivated. Capability unit IIIe–5; pasture and hayland group 7A; woodland suitability group not assigned.

Desha Series

The Desha series consists of deep, nearly level to gently sloping, clayey, alkaline soils on bottom lands. These soils formed in clayey alluvial deposits.

In a representative profile the surface layer is dark reddish-brown clay about 6 inches thick. The next layer is clay. The upper 22 inches is dark reddish-brown clay. The next 32 inches is dark-brown clay. Below this to a depth of 96 inches is dark reddish-brown clay that contains a few concretions of calcium carbonate.

Desha soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. These soils have a high potential as pastureland and woodland and medium potential as cropland.

Representative profile of Desha clay, 0 to 1 percent slopes, east of Clarksville on U.S. Highway No. 82 to Farm Road No. 114, east on Farm Road No. 114 to junction with Farm Road No. 1699, 2.5 miles north on Farm Road No. 1699, east on county road to Chapman Ranch, 2 miles north on levee road to south end of levee, 0.75 mile north, in pasture:

Ap—0 to 6 inches, dark reddish-brown (5YR 3/2) clay; moderate, fine, subangular blocky structure; very hard, firm, plastic; few worm casts filled with reddish brown (5YR 4/3); shiny faces on peds; mildly alkaline; abrupt, smooth boundary.

B1—6 to 20 inches, dark reddish-brown (5YR 3/2) clay; moderate, medium, subangular blocky structure; very hard, firm, plastic; shiny faces on peds; mildly alkaline; clear, wavy boundary.

B21—20 to 28 inches, dark reddish-brown (5YR 3/4) clay; few, faint, vertical streaks and dark reddish-brown (5YR 3/2) mottles; moderate, medium, subangular blocky structure; very hard, firm, plastic; few fine slickensides and shiny faces on peds; mildly alkaline; gradual, smooth boundary.

B22—28 to 60 inches, dark-brown (7.5YR 3/2) clay; moderate, medium, blocky structure; very hard, firm, plastic; common slickensides 1 to 3 inches across that begin to intersect at a depth of 40 inches; mildly alkaline; gradual, smooth boundary.

B3—60 to 96 inches, dark reddish-brown (5YR 3/3) clay; massive; very hard, firm, plastic; intersecting slickensides more pronounced than in horizon above; 1 to 2 percent concretions of calcium carbonate less than 0.5 inch in diameter; mildly alkaline.

The solum ranges from 40 inches to about 100 inches in thickness. It is slightly acid to mildly alkaline throughout. Intersecting slickensides start at a depth of 36 to 45 inches.

The A horizon is 5 to 9 inches thick. It is dark brown or dark reddish brown and contains 35 to 60 percent clay.

The B1 horizon is dark brown or dark reddish brown and contains 35 to 60 percent clay. The B2 horizon is dark reddish brown, brown, very dark brown, or reddish brown and is mottled in some profiles with very dark gray, very dark brown, and black. In some profiles it has concretions of calcium carbonate. The B2 horizon is 60 to 75 percent clay. The B3 horizon, where present, contains a few concretions of calcium carbonate below a depth of 40 inches.

Desha clay, 0 to 1 percent slopes (DeA).—This nearly level soil is on flood plains. Areas are 10 acres to more than 1,000 acres but average about 75 acres. They are irregular in shape. Slopes average 0.5 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Desha clay, 1 to 3 percent slopes, that occur on the outside edge of mapped areas and make up 5 to 10 percent of some mapped areas. Also included are slightly elevated areas of Redlake soils, 5 to 15 acres in size, that make up 5 to 20 percent of some mapped areas and small depressional areas of Muldrow soils, 3 to 10 acres in size, that make up 5 to 10 percent of mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 35 percent of the acreage is used for pasture, 45 percent is in hardwood trees, and 20 percent is cultivated. Capability unit IIIw–2; pasture and hayland group 1A; woodland suitability group 2w6.

Desha clay, 1 to 3 percent slopes (DeB).—This gently sloping soil is on flood plains. Areas are 10 to 50 acres but average about 20 acres. They are long and narrow. Slopes average about 2 percent.

The surface layer is dark-brown clay about 6 inches thick. Below this to a depth of about 46 inches is dark reddish-brown clay that contains a few concretions of calcium carbonate in the lower 17 inches.

Included with this soil in mapping are areas of Redlake soils, 3 to 5 acres in size, that make up 5 to 10 percent of mapped areas. Also included are areas of Desha clay, 0 to 1 percent slopes, 5 to 10 acres in size, that make up 10 to 15 percent of mapped areas.

Runoff is slow. The hazard of erosion is moderate.

About 50 percent of the acreage is used for pasture, and 50 percent is wooded. Capability unit IIIw–2; pasture and hayland group 1A; woodland suitability group 2w6.

Ellis Series

The Ellis series consists of moderately deep, gently sloping, clayey, alkaline soils on uplands. These soils formed in shale. They are on side slopes along drainageways.

In a representative profile the surface layer is dark grayish-brown clay about 3 inches thick. The next layer is 16 inches of dark-gray clay. The underlying material is 12 inches of gray clay that contains fragments of shale. Below this to a depth of 36 inches is shale.

Ellis soils are well drained. Permeability is very slow, and available water capacity is medium. These soils have a medium potential as pastureland and cropland and a low potential as woodland.

Representative profile of Ellis clay, 3 to 5 percent slopes, 12 miles south of the junction of Texas Highway No. 37 and U.S. Highway No. 82 in Clarksville; 0.5 mile east on county road, 2,900 feet east on private road to pasture gate, 3,200 feet south, in pasture:

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) clay; moderate, medium, subangular blocky structure; extremely hard, very firm, plastic; calcareous; moderately alkaline; gradual, smooth boundary.

B2—3 to 10 inches, dark-gray (10YR 4/1) clay; weak, medium to coarse, blocky structure; extremely hard, very firm, plastic; many shiny pressure faces; calcareous; moderately alkaline; gradual, smooth boundary.

B3—10 to 19 inches, dark-gray (10YR 4/1) clay; many, fine to coarse, distinct, olive (5Y 5/3) mottles; weak, medium, blocky structure; extremely hard, very firm, plastic; many slickensides; few fine concretions of ferromanganese; some faces coated with very dark gray (10YR 3/1); about 2 percent concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C1—19 to 31 inches, gray (5Y 5/1) clay and partly weathered shale; many, fine, distinct, olive (5Y 5/3) specks and few black (10YR 2/1) streaks; weak, medium, platy structure; extremely hard, very firm; some faces coated with very dark gray (10YR 3/1); common slickensides; few concretions of calcium carbonate; calcareous; moderately alkaline; clear, irregular boundary.

C2—31 to 36 inches, grayish-brown (2.5Y 5/2) shale; pockets of olive brown (2.5Y 4/4) and gray (5Y 6/1); massive; extremely hard, extremely firm; calcareous; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. When dry it has a crust that ranges from 1/16 to 1/4 inch in thickness.

The A horizon is dark grayish brown, light brownish gray, or pale brown. It is neutral to moderately alkaline.

The B horizon is dark grayish brown, light brownish gray, pale brown, gray, or very pale brown and is mottled with gray, olive, or yellow. It is neutral to moderately alkaline. The B horizon is as much as 3 percent calcium carbonate.

The C horizon is mottled gray to olive. It is mildly alkaline to moderately alkaline and is calcareous in places. It is as much as 3 percent calcium carbonate. The shale is gray, grayish brown, or olive, and it is calcareous.

Ellis clay, 3 to 5 percent slopes (EsC).—This gently sloping soil is on convex side slopes. Areas are 10 to 150 acres but average about 25 acres. They are long and narrow. Slopes average about 4 percent.

Included with this soil in mapping are a few areas of Burleson soils, 2 to 6 acres in size, that make up 10 percent of some mapped areas. Also included are areas of Ferris soils, 5 to 10 acres in size, that make up 10 to 15 percent of mapped areas and a few areas of Ellis clay that have gullies 500 to 600 feet apart, 2 to 4 feet deep, and 3 to 8 feet across; these areas make up 15 to 20 percent of some mapped areas.

Runoff is rapid. The hazard of erosion is severe.

About 70 percent of this soil is used for pasture, 20 percent is wooded, and 10 percent is cultivated. Capability unit IVe–1; pasture and hayland group 7A; woodland suitability group not assigned.

Elysian Series

The Elysian series consists of deep, nearly level to gently sloping, loamy, acid soils on uplands and terraces. These soils formed in loamy sediment.

In a representative profile the surface layer is brown fine sandy loam about 4 inches thick. The next layer is 16 inches of brown fine sandy loam. The next layer is 21 inches of strong-brown loam that has streaks and pockets of light yellowish-brown fine sandy loam. The next layer is 24 inches of strong-brown loam mottled with yellowish brown and yellowish red. Below this to a depth of 90 inches is yellowish-red loam.

Elysian soils are well drained. Permeability is moderate, and available water capacity is medium. These soils have a high potential as pastureland and woodland and a medium potential as cropland.

Elysian soils in Red River County are mapped only in complexes with Bernaldo, Muldrow, and Whakana soils.

Representative profile of Elysian fine sandy loam in an area of Muldrow-Elysian complex, 17.9 miles north of Clarksville on Texas Highway No. 37, west on Farm Road No. 196 to Farm Road No. 410, about 6 miles north on Farm Road No. 410 to field road, 0.75 mile southwest, in field:

Ap—0 to 4 inches, brown (7.5YR 5/4) fine sandy loam; weak, fine, granular structure; slightly hard, very friable; medium acid; clear, smooth boundary.

B1—4 to 20 inches, brown (7.5YR 5/4) fine sandy loam; weak, fine, subangular blocky structure; slightly hard, very friable; slightly acid; clear, wavy boundary.

B21t&A'2—20 to 41 inches, strong-brown (7.5YR 5/6) loam; weak, fine, subangular blocky structure; slightly hard, very friable; patchy clay films on faces of peds; 15 to 25 percent tongues and pockets of light yellowish-brown (10YR 6/4) fine sandy loam; medium acid; gradual, wavy boundary.

B22t&A'2—41 to 65 inches, strong-brown (7.5YR 5/6) loam; common, fine, distinct, yellowish-brown (10YR 5/4) mottles and few, fine, faint, yellowish-red (5YR 5/6) mottles; weak, medium, subangular blocky structure; hard, firm; few streaks and tongues of fine sandy loam; patchy clay films, few soft masses of ferromanganese; strongly acid; gradual boundary.

B3—65 to 90 inches, yellowish-red (5YR 4/8) loam; weak, medium, subangular blocky structure; slightly hard, very friable; few soft masses of ferromanganese; strongly acid.

The solum is more than 60 inches thick.

The Ap or A1 horizon ranges from 4 to 6 inches in thickness. It is brown, dark grayish brown, light brown, yellowish brown, or pale brown. It is slightly acid to medium acid.

The B1 horizon ranges from 12 to 24 inches in thickness. It is brown, dark grayish brown, light brown, yellowish brown, pale brown, strong brown, light yellowish brown, or brownish yellow. It is slightly acid to medium acid. The Bt&A'2 horizon is strong brown, light yellowish brown, yellowish brown, or brownish yellow and is mottled with yellowish red, brown, or light yellowish brown. A'2 material comprises 10 to 30 percent of the horizon. The horizon is very strongly acid to medium acid.

Ferris Series

The Ferris series consists of deep, gently sloping to sloping, clayey, alkaline soils on uplands. These soils formed in calcareous clayey sediment. They are on side slopes along drainageways.

In a representative profile the surface layer is olive-gray clay about 10 inches thick. The next layer is 39 inches of clay. The upper 11 inches is olive; the middle 12 inches is light yellowish brown and is mottled with very dark grayish brown, and the lower 16 inches is

olive yellow and is mottled with light gray. The underlying material to a depth of 80 inches is shale (fig. 4).

Ferris soils are well drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and a low potential as cropland and woodland.

Representative profile of Ferris clay, 3 to 8 percent slopes, eroded, 3.5 miles north of intersection of U.S. Highway No. 82 and Texas Highway No. 37, on Texas Highway No. 37, 2,500 feet east on private road, 30 feet north of road:

Ap—0 to 10 inches, olive-gray (5Y 4/2) clay; weak, fine, blocky structure; extremely hard, very firm; very plastic; few fine roots; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

AC1—10 to 21 inches, olive (5Y 4/3) clay; many, medium, faint, olive (5Y 5/3) mottles; weak, coarse, prismatic structure parting to moderate, fine, blocky; extremely hard, very firm, very plastic; few intersecting slickensides; many shiny pressure faces; worm channels and cracks filled with very dark grayish brown (2.5Y 3/2); about 5 percent concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

AC2—21 to 33 inches, light yellowish-brown (2.5Y 6/4) clay; few, coarse, distinct, very dark grayish-brown (2.5Y 3/2) mottles; weak, coarse, prismatic structure parting to moderate, fine, blocky; extremely hard, very firm, very plastic; common intersecting slickensides; worm channels and cracks filled with very dark grayish brown (2.5Y 3/2); about 10 percent concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

AC3—33 to 49 inches, olive-yellow (2.5Y 6/6) clay; common, fine, distinct, light-gray (5Y 7/1) mottles; weak, medium, prismatic structure; extremely hard, very firm, very plastic; few concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

C—49 to 80 inches, stratified, light yellowish-brown (2.5Y 6/4), pale-brown (10YR 6/3), and light-gray (5Y 7/1) shale; few fine masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 30 to 60 inches in thickness. The A horizon ranges from 5 to 10 inches in thickness. It is olive gray, olive brown, olive, or dark grayish brown. The AC horizon ranges from 24 to 42 inches in thickness. It is olive brown to light yellowish brown, olive yellow, or olive. The C horizon is shaly clay or slightly weathered calcareous shale.

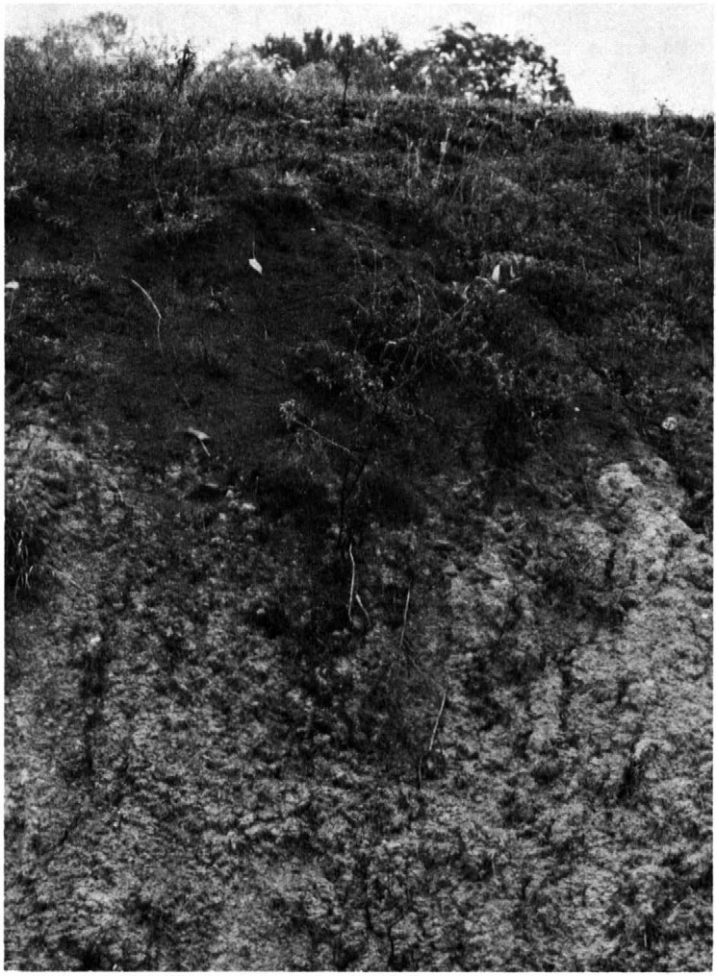


Figure 4.—**Wavy boundary in a profile of Ferris clay, 3 to 8 percent slopes, eroded.**

Ferris clay, 3 to 8 percent slopes, eroded (FeD2).—This gently sloping to sloping soil is on convex side slopes. Areas are 10 to 100 acres but average about 30 acres. They are long and narrow. Areas have V-shaped gullies 3 to 5 feet deep, 20 to 30 feet across at the top, and 100 to 200 feet apart.

Included with this soil in mapping are areas of a soil on foot slopes. It is similar to Ferris clay but has a darker, thicker surface layer. Areas of this soil are 3 to 7 acres in size and make up 10 to 20 percent of a few mapped areas. Also included are areas of Houston Black soils, 5 to 10 acres in size, that make up 15 to 20 percent of mapped areas and a few areas of Ellis soils, 3 to 5 acres in size, that make up 5 to 10 percent of some mapped areas.

Runoff is rapid. The hazard of erosion is severe.

About 80 percent of the acreage is used for pasture, and 20 percent is cultivated. Capability unit VIe–2; pasture and hayland group 7B; woodland suitability group not assigned.

Freestone Series

The Freestone series consists of deep, nearly level, loamy, acid soils on high terraces and uplands. These soils formed in loamy sediment. They are on plane to slightly concave positions on the landscape.

In a representative profile the surface layer is fine sandy loam about 10 inches thick. The upper 6 inches is brown, and the lower 4 inches is pale brown. The next layer is 14 inches of yellowish-brown sandy clay loam mottled with gray and yellowish red. The next layer is 14 inches of dark-red sandy clay loam that is mottled with gray and yellowish brown and contains lenses and pockets of uncoated sand. The next layer is 10 inches of strong-brown clay mottled with yellowish brown and gray. Below this to a depth of 76 inches is coarsely mottled, yellowish-brown and gray clay loam.

Freestone soils are moderately well drained. Permeability is slow, and available water capacity is medium.

These soils have a high potential as pastureland and a medium potential as cropland and woodland.

Representative profile of Freestone fine sandy loam in an area of Freestone-Addielou complex, 0 to 1 percent slopes, 2.3 miles west of Avery on county road along railroad, 100 feet north of railroad crossing:

Ap—0 to 6 inches, brown (10YR 5/3) fine sandy loam; single-grained; hard, very friable; common fine roots; slightly acid; abrupt, smooth boundary.

A2—6 to 10 inches, pale-brown (10YR 6/3) fine sandy loam; single-grained; hard, very friable; many fine roots; strongly acid; clear, wavy boundary.

B21t—10 to 24 inches, yellowish-brown (10YR 5/8) sandy clay loam; many, medium, distinct, gray (10YR 6/1) mottles, and few, fine, prominent, yellowish-red (5YR 4/8) mottles; moderate, coarse, subangular structure; very hard, friable; patchy clay films; very strongly acid; gradual boundary.

B22t&A'2—24 to 38 inches, dark-red (2.5YR 3/6) sandy clay loam; many, fine and medium, prominent, gray (10YR 5/1) mottles and few, distinct, yellowish-brown (10YR 5/4) mottles; moderate, coarse, prismatic structure parting to moderate, fine, blocky; very hard, firm, plastic patchy clay films; 10 to 15 percent pockets and streaks of light-gray (10YR 6/1) uncoated sand and silt on faces of peds; very strongly acid; diffuse, wavy boundary.

B23t—38 to 48 inches, strong-brown (7.5YR 5/6) clay; few, fine, distinct, yellowish-brown (10YR 5/6) and gray (10YR 6/1) mottles; weak, medium, blocky structure; very hard, firm, sticky; patchy clay films; medium acid; diffuse boundary.

B24t—48 to 76 inches, coarsely mottled yellowish-brown (10YR 5/4, 10YR 5/8) and gray (10YR 6/1) clay loam; moderate, coarse, blocky structure; hard, friable; patchy clay films; few masses of ferromanganese; few spots of white neutral salts; slightly acid.

The solum is more than 75 inches thick.

The Ap or A1 horizon ranges from 3 to 8 inches in thickness. It is dark grayish brown or brown. It is medium acid to neutral. The A2 horizon ranges from 4 to 10 inches in thickness. It is light yellowish brown to very pale brown, brown, or pale brown. It is strongly acid to slightly acid.

The B21t horizon is yellowish-brown, reddish-yellow, or strong-brown loam or sandy clay loam. Some pedons have few to common mottles in shades of gray, yellow, or red. This horizon is very strongly acid to medium acid. The upper part of the Bt horizon that is less than 35 percent clay ranges from 16 to 30 inches in thickness. The B22t&A'2 horizon is sandy clay loam or clay loam mottled in shades of brown, red, and gray. The B23t and B24t horizons are shades of gray, red, yellow, and brown clay loam or clay that contains 35 to 50 percent clay. They are medium acid to neutral.

Freestone-Addielou complex, 0 to 1 percent slopes (FrA).—This complex is about 55 percent Freestone fine sandy loam, 25 percent Addielou fine sandy loam, and 20 percent other soils. It is in nearly level, plane or weakly concave areas between or around the heads of drainageways. Slopes average about 0.5 percent. Areas are irregular in shape. They are 10 to 125 acres but average about 30 acres.

This complex is characterized by areas of Freestone soils from which circular mounds of Addielou soils protrude in a random pattern. The mounds are too small to separate at the scale used in mapping. They are 1 to 4 feet high, 40 to 100 feet in diameter, and 150 to 200 feet apart.

The Addielou soil has a surface layer of brown fine sandy loam about 4 inches thick. The next layer is 32 inches of light yellowish-brown fine sandy loam. The next layer is 18 inches of yellowish-brown sandy clay loam that has gray mottles and streaks of uncoated sand. Below this to a depth of about 75 inches is yellowish-brown, red, and gray sandy clay loam.

Included with this complex in mapping are areas of Wrightsville soils, 5 to 10 acres in size, that make up 10 to 15 percent of some mapped areas. Also included are areas of Annona soils, 3 to 5 acres in size, that are in intermound areas and make up 5 to 10 percent of some mapped areas and a few areas of Rodessa soils on some mounds that make up 5 to 10 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 75 percent of this complex is used for pasture, 20 percent is wooded, and 5 percent is cultivated. Both soils in capability unit IIw–2; both soils in pasture and hayland group 8C; Freestone part in woodland suitability group 3w8, Addielou part in woodland suitability group 3o7.

Gladewater Series

The Gladewater series consists of deep, nearly level, clayey, acid soils on bottom lands. These soils formed in Recent alluvial deposits.

In a representative profile the surface layer is very dark gray clay about 6 inches thick. The next layer is 18 inches of light brownish-gray clay mottled with yellowish brown. The next layer is 16 inches of gray clay mottled with yellowish brown. The underlying material to a depth of 65 inches is gray clay stratified with gray clay loam. It is mottled with yellowish brown and dark yellowish brown.

Gladewater soils are poorly drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and a high potential as woodland. Where the hazard of flooding can be controlled, they have a medium potential as cropland.

Representative profile of Gladewater clay, 8.4 miles south of junction of Texas Highway No. 37 and Farm Road No. 909, on Farm Road No. 909, 1.75 miles east on private road, 600 feet south of private road on Cut hand Creek flood plain:

Ap—0 to 6 inches, very dark gray (10YR 3/1) clay; moderate, fine, subangular blocky structure; extremely hard, very firm, very plastic; many fine roots; slightly acid; clear, smooth boundary.

B21g—6 to 24 inches, light brownish-gray (10YR 6/2) clay; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine and very fine, blocky structure; extremely hard, very firm, very plastic; few fine roots; very strongly acid; gradual, wavy boundary.

B22g—24 to 40 inches, gray (10YR 6/1) clay; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, coarse, blocky structure; extremely hard, very firm, very plastic; few roots; few pressure faces 2 to 4 inches across; strongly acid; gradual, wavy boundary.

Cg—40 to 65 inches, gray (10YR 5/1) clay; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; stratified with gray (10YR 6/1) clay loam that has distinct, yellowish-brown (10YR 5/6) mottles; massive; extremely hard, very firm, very plastic; few roots; neutral.

The A horizon ranges from 4 to 9 inches in thickness. It is black, very dark gray, very dark grayish brown, or dark brown. It is medium acid to neutral.

The B2g horizon is dark gray, gray, light brownish gray, or olive gray and has few to common, faint or distinct mottles of yellowish brown, dark yellowish brown, or reddish brown. It is clay or silty clay that contains 40 to 60 percent clay. It is very strongly acid to slightly acid, but in some subhorizons it is strongly acid to slightly acid above a depth of 40 inches.

The Cg horizon is gray or dark gray. In some profiles it has distinct mottles of yellowish brown or strong brown. It is clay, but in some profiles it is stratified with clay loam or silty clay loam. It is strongly acid to neutral.

Gladewater clay (Gd).—This nearly level soil is on areas of bottom land protected by levees. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is plane to weakly concave. Areas are irregular in shape. They are 100 to 600 acres in size but average about 150 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few long, narrow areas of Kaufman clay, 1 to 3 percent slopes. These areas are 5 to 10 acres and make up 5 to 10 percent of some mapped areas. Also included, along sloughs, are a few long, narrow areas of Gladewater clay that has slopes of 1 to 3 percent. These areas make up 5 to 10 percent of some mapped areas.

Runoff is very slow. The hazard of erosion is slight. About 30 percent of the acreage is used for pasture, 20 percent is wooded, and 50 percent is cultivated. Capability unit IIIw–2; pasture and hayland group IB; woodland suitability group 2w6.

Gladewater clay, frequently flooded (Gf).—This nearly level soil is in areas on bottom lands. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is plane to weakly concave and is broken by frequent scour channels. Areas are 95 to 600 acres but average about 250 acres. They are flooded 1 to 3 times a year, mainly during spring, for periods of 3 to 6 days.

The surface layer is very dark gray clay about 8 inches thick. The next layer is 14 inches of dark-gray clay. The underlying material to a depth of about 60 inches is gray clay mottled with shades of brown.

Included with this soil in mapping are a few areas of Kaufman clay 5 to 10 acres in size. These areas occur in slightly better drained positions on the landscape and make up less than 10 percent of mapped areas. Also included are a few areas of Nahatche soils near tributaries. The areas are 5 to 10 acres in size and make up less than 10 percent of mapped areas.

Runoff is very slow. The hazard of erosion is slight.

About 50 percent of the acreage is used for pasture, and 50 percent is wooded (fig. 5). Capability unit Vw–3; pasture and hayland group 1B; woodland suitability group 2w6.

Figure 5.—**Hardwood forest in an area of Gladewater clay, frequently flooded. This area is used extensively by wildlife.**

Hapludalfs, Loamy

Hapludalfs, loamy, consists of deep, nearly level to gently sloping, loamy, acid soils on terraces. These soils formed in loamy sediment.

In a representative profile the surface layer is dark-brown fine sandy loam about 7 inches thick. The next layer is 8 inches of dark-brown loam. The next layer is 13 inches of dark reddish-brown sandy clay loam. The next layer is 12 inches of yellowish-red clay loam. The underlying material to a depth of 60 inches is yellowish-red stratified fine sandy loam and sandy clay loam.

Hapludalfs, loamy, are well drained. Permeability is moderate, and available water capacity is medium. These soils have a high potential as pastureland, cropland, and woodland.

Representative profile of Hapludalfs, loamy, 0 to 2 percent slopes, 26 miles northwest of Clarksville to Kiomatia, 3.8 miles north of Kiomatia on Farm Road No. 410, 1.5 miles east on Farm Road No. 410, 0.5 mile north to farm headquarters, 0.2 mile east of headquarters:

Ap—0 to 7 inches, dark-brown (10YR 4/3) fine sandy loam; weak, fine, granular structure; hard, very friable; slightly acid; clear, smooth boundary.

A1—7 to 15 inches, dark-brown (10YR 3/3) loam; color slightly lighter when crushed; weak, fine, subangular blocky and granular structure; hard, friable; common fine and medium pores, slightly acid; gradual, smooth boundary.

B21t—15 to 38 inches, dark reddish-brown (5YR 3/4) sandy clay loam; weak, fine, subangular blocky structure; very hard, firm; few to common fine pores; few patchy clay films; medium acid; gradual, smooth boundary.

B22t—38 to 50 inches, yellowish-red (5YR 4/6) clay loam; weak, medium, subangular blocky structure; hard, friable; slightly acid; gradual, smooth boundary.

C—50 to 60 inches, yellowish-red (5YR 4/6) stratified fine sandy loam and sandy clay loam; massive; hard, friable; slightly acid.

The solum ranges from 45 to 80 inches in thickness.

The Ap or A1 horizon ranges from 5 to 19 inches in thickness. It is dark-brown, dark yellowish-brown, dark reddish-gray, reddish-brown, dark reddish-brown, or yellowish-red fine sandy loam, very fine sandy loam, or loam. It is medium acid or slightly acid.

The B2t horizon is dark reddish brown, reddish brown, dark brown, brown, strong brown, yellowish red, or red. It is loam, sandy clay loam, or clay loam. It is medium acid or slightly acid.

The C horizon is yellowish red, red, or brown stratified fine sandy loam. It is slightly acid or neutral.

Hapludalfs, loamy, 0 to 2 percent slopes (HaB).—This nearly level to gently sloping soil is on terraces. Slopes average less than 1 percent, and the surface is plane to weakly convex. Areas are irregular in shape. They are 15 to 500 acres but average about 30 acres.

Included with this soil in mapping are slightly depressional areas of Waskom and Muldrow soils, less than 5 acres in size, that make up 5 to 10 percent of mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 20 percent of the acreage is used for pasture, and 80 percent is cultivated. Capability unit I–1; pasture and hayland group 2A; woodland suitability group 2o4.

Houston Black Series

The Houston Black series consists of deep, gently sloping, clayey, alkaline soils on uplands. These soils formed in calcareous clay and marl.

In a representative profile the surface layer is black clay about 20 inches thick. The next layer is 49 inches of clay. It is very dark gray in the upper 24 inches and dark grayish brown in the lower 25 inches. The underlying material to a depth of 72 inches is shale.

Houston Black soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils have a high potential as pastureland and cropland and a low potential as woodland.

Representative profile of Houston Black clay, 1 to 3 percent slopes, 3.5 miles north of intersection of U.S. Highway No. 82 and Texas Highway No. 37, 5,600 feet east on private road and 800 feet south:

Ap—0 to 7 inches, black (10YR 2/1) clay; moderate, medium, granular structure; extremely hard, very firm, very plastic; few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

A11—7 to 20 inches, black (10YR 2/1) clay; moderate, fine, blocky structure; few intersecting slickensides below a depth of 16 inches; extremely hard, very firm, very plastic; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

A12—20 to 44 inches, very dark gray (10YR 3/1) clay; dark gray (10YR 4/1) when dry; weak, fine, blocky structure, extremely hard, very firm, very plastic; intersecting slickensides; few specks of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

AC—44 to 69 inches, dark grayish-brown (10YR 4/2) clay; weak, medium and coarse, angular blocky structure; extremely hard, very firm; very plastic; intersecting slickensides; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

C—69 to 72 inches, stratified, light-gray (2.5Y 7/2) and light yellowish-brown (2.5Y 6/4) shale; extremely hard, very firm, plastic; calcareous; moderately alkaline.

The solum ranges from 60 to 75 inches in thickness. When dry it has cracks at a depth of 20 inches that range from 1 to 2 inches in width. Intersecting slickensides begin at a depth of 16 to 24 inches. The solum is 45 to 60 percent clay.

The A horizon ranges in thickness from 10 inches on microknolls to 50 inches in microdepressions. It is very dark gray or black. The AC horizon ranges from 12 to 40 inches in thickness. It is dark grayish brown, light brownish gray, olive, or dark grayish brown. In most profiles it has few to common mottles of gray to strong brown.

The C horizon is light gray, light yellowish brown, or pale brown and has mottles of yellow, brown, or olive.

Houston Black clay, 1 to 3 percent slopes (HoB).—This gently sloping soil is on ridgetops and foot slopes. Slopes average about 2 percent, and the surface is convex. Areas are irregular in shape. They are 10 to 75 acres but average about 40 acres.

Included with this soil in mapping are areas of Burleson clay that are in less sloping parts of some mapped areas. They are 3 to 7 acres in size and make up 10 to 20 percent of some mapped areas. Also included are areas of Austin soils on narrow ridges. They are 2 to 5 acres in size and make up less than 5 percent of mapped areas. There are also a few small areas of

steep Ferris soils, 5 to 10 acres in size, that make up 5 to 10 percent of mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 60 percent of the acreage is used for pasture, and 40 percent is cultivated. Capability unit IIe–2; pasture and hayland group 7A; woodland suitability group not assigned.

Kaufman Series

The Kaufman series consists of deep, nearly level, clayey, alkaline soils on bottom lands. These soils formed in Recent alluvial deposits.

In a representative profile the surface layer is very dark gray clay about 15 inches thick. Below this to a depth of 70 inches is dark-gray clay.

Kaufman soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. These soils have a high potential as pastureland and woodland. Where the hazard of flooding can be controlled, they have a high potential as cropland.

Representative profile of Kaufman clay, frequently flooded, east of Clarksville on U.S. Highway No. 82 to Annona, south on Farm Road No. 44 to Boxelder, 3 miles south on county road, 1 mile east on private road, 2.5 miles south on private road, 100 feet west of private road:

A1—0 to 15 inches, very dark gray (10YR 3/1) clay; moderate, fine, blocky structure; extremely hard, very firm, plastic; mildly alkaline; diffuse, wavy boundary.

B21g—15 to 33 inches, dark-gray (10YR 4/1) clay; common, fine and medium, distinct, strong-brown (7.5YR 5/6) and light olive-brown (2.5Y 5/4) mottles; moderate, very fine, blocky structure; extremely hard, very firm, plastic; few slickensides 1 to 2 inches wide; medium acid; diffuse, wavy boundary.

B22g—33 to 70 inches, dark-gray (10YR 4/1) clay; moderate, medium, blocky structure; extremely hard, very firm, plastic; many slickensides 2 to 5 inches wide that intersect below a depth of 40 inches; slightly acid.

The solum is clay or silty clay. It is medium acid to mildly alkaline.

The A horizon ranges from 10 to 20 inches in thickness. It is black or very dark gray. It is 60 to 70 percent clay.

The Bg horizon is dark gray or gray. In some profiles it has mottles in shades of yellow, olive, or brown.

Kaufman soils in Red River County have a surface layer that is a few inches thinner than is defined as within the range for the series, but this difference does not alter their use and behavior.

Kaufman clay (Ka).—This nearly level soil is in areas of bottom lands that are protected by levees. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is plane to weakly concave. Areas are oblong. They are 100 to 1,000 acres but average about 300 acres.

The surface layer is very dark gray clay about 13 inches thick. The next layer is 24 inches of gray clay. Below this to a depth of about 73 inches is gray clay mottled with yellowish brown.

Included with this soil in mapping area areas of Gladewater soils in more poorly drained areas. They are 1 to 8 acres in size and make up 5 to 10 percent of mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 25 percent of the acreage is used for pasture, 5 percent is wooded, and 70 percent is cultivated. Capability unit IIw–1; pasture and hayland group 1A; woodland suitability group 1w6.

Kaufman clay, frequently flooded (Kb).—This nearly level soil is in areas on bottom lands. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is plane to weakly concave. Areas are long and narrow. They are 30 to 2,000 acres but average about 200 acres. The soil is flooded 1 or 2 times a year for periods of 1 to 5 days, mainly during the growing season. It is dissected by shallow scour channels. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Gladewater clay in depressions. They are 10 to 20 acres in size and make up 5 to 15 percent of mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 50 percent of the acreage is used for pasture, and 50 percent is wooded. Capability unit Vw–3; pasture and hayland group 1A; woodland suitability group 1w6.

Kenney Series

The Kenney series consists of deep, gently sloping to sloping, sandy, acid soils on terraces. These soils formed in loamy material.

In a representative profile the surface layer is a dark-brown loamy fine sand about 14 inches thick. The next layer is 38 inches of light yellowish-brown loamy fine sand. Below this to a depth of 84 inches is red sandy clay loam mottled with strong brown in the upper part (fig. 6).

Kenney soils are well drained. Permeability is moderately rapid, and available water capacity is low. These soils have a medium potential as pastureland and woodland and a low potential as cropland.

Representative profile of Kenney loamy fine sand, 2 to 8 percent slopes, 2.5 miles west of Manchester Store, on county road, 100 feet north of county road:

A1—0 to 14 inches, dark brown (10YR 4/3) loamy fine sand; single-grained; loose; medium acid; diffuse, wavy boundary.

A21—14 to 36 inches, light yellowish-brown (10YR 6/4) loamy fine sand; few, fine, faint, pale-brown (10YR 6/3) mottles; single-grained; loose; medium acid; clear, wavy boundary.

A22—36 to 52 inches, light yellowish-brown (10YR 6/4) loamy fine sand; single-grained; loose; slightly acid; clear, wavy boundary.

B21t—52 to 71 inches, red (2.5YR 4/8) sandy clay loam; medium, distinct, strong-brown (7.5YR 5/8) mottles; moderate, medium, subangular blocky structure; hard, firm, slightly plastic; many patchy clay films; few root channels filled with uncoated sand; strongly acid; diffuse, wavy boundary.

B22t—71 to 84 inches, red (2.5YR 5/8) sandy clay loam; weak, medium, subangular blocky structure; hard, friable, slightly plastic; few clay films; medium acid.

The solum ranges from 65 inches to more than 100 inches in thickness. It is strongly acid to slightly acid.

The A1 horizon ranges from 12 to 20 inches in thickness. It is brown, grayish brown, or dark brown. The A2 horizon ranges from 20 to 44 inches in thickness. It is light yellowish brown, very pale brown, or brown. A few dark-brown and

reddish-brown lamellae occur in some pedons. These lamellae are about ⅛ inch thick and total 1 to 1½ inches in thickness.

The B2t horizon is yellowish red, strong brown, or red and has mottles of strong brown or brownish yellow in some profiles. The upper 20 inches is 18 to 30 percent clay.

Kenney loamy fine sand, 2 to 8 percent slopes (KeD).—This gently sloping to sloping soil is on stream divides. Slopes average about 5 percent, and the surface is convex. Areas are irregular in shape. They are 10 to 100 acres but average about 30 acres.

Included with this soil in mapping are areas of Vesey soils, 3 to 10 acres in size, that make up 5 to 10 percent of some mapped areas. Also included are a few areas of Rosalie soils, 10 to 15 acres in size, that make up 10 to 15 percent of some mapped areas.

Runoff is very slow. The hazard of erosion is slight.

About 70 percent of the acreage is used for pasture, 15 percent is wooded, and 15 percent is cultivated. Capability unit IIIe–4; pasture and hayland group 9B; woodland suitability group 3s2.

***Figure 6.*—Profile of Kenney loamy fine sand, 2 to 8 percent slopes. Light-colored A2 horizon is between depths of about 14 and 52 inches.**

Kiomatia Series

The Kiomatia series consists of deep, gently sloping, sandy, alkaline soils on bottom lands. These soils formed in Recent alluvium.

In a representative profile the surface layer is brown loamy fine sand about 4 inches thick. The underlying material extends to a depth of 60 inches. The upper part is 5 inches of light-brown fine sand, the next part is 6 inches of brown very fine sandy loam, and the lower part is 45 inches of light-brown fine sand.

Kiomatia soils are well drained. Permeability is rapid, and available water capacity is low. These soils have a medium potential as pastureland, a high potential as woodland, and a low potential as cropland.

Representative profile of Kiomatia loamy fine sand, frequently flooded, 1 mile east of Clarksville on U.S. Highway No. 82 to Farm Road No. 114, east on Farm Road No. 114 to English, north on Farm Road No. 1699 to end, north on county road to end, 3 miles north on private road, 200 yards south of Red River, in pasture:

A1—0 to 4 inches, brown (7.5YR 5/4) loamy fine sand; single-grained; slightly hard, very friable; few fine roots; few fine strata of reddish-brown (5YR 5/4) fine sandy loam; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—4 to 9 inches, light-brown (7.5YR 6/4) fine sand; single-grained; loose; common fine and medium strata of reddish-brown (2.5YR 5/4) loamy fine sand and fine sandy loam; calcareous; moderately alkaline; abrupt, smooth boundary.

C2—9 to 15 inches, brown (7.5YR 5/4) very fine sandy loam; single-grained; soft, very friable; few fine and medium strata of dark grayish-brown (10YR 4/2) fine sandy loam; calcareous, moderately alkaline; abrupt, smooth boundary.

C3—15 to 60 inches, light-brown (7.5YR 6/4) fine sand; single-grained; loose; many fine and medium strata of reddish-brown (5YR 5/4) very fine sandy loam and pale-brown (10YR 6/3) loamy fine sand; calcareous; moderately alkaline.

The A horizon ranges from 2 to 10 inches in thickness. It is brown, strong brown, light brown, pink, light reddish brown, reddish brown, or dark reddish gray.

The C horizon is reddish brown, light reddish brown, pink, brown, light brown, or strong brown. It is fine sand or loamy fine sand stratified with loamy very fine sand. In some profiles it is finer-textured.

Kiomatia loamy fine sand, frequently flooded (Ko).—This nearly level to gently sloping soil is in areas of bottom lands. Slopes are 1 to 3 percent but average about 1.5 percent. Areas are long and narrow. They are 20 to 40 acres but average about 30 acres. The soil is flooded 3 or 4 times a year for periods of 3 to 10 days, mainly during the growing season.

Included with this soil in mapping are areas of Oklared and Redlake soils in the higher part of mapped areas. They are less than 5 acres in size and make up 10 to 20 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 60 percent of the acreage is used for pasture, and 40 percent is wooded. Capability unit Vw–2; pas-

ture and hayland group 3A; woodland suitability group 2w5.

Kullit Series

The Kullit series consists of deep, gently sloping, loamy, acid soils on uplands and terraces. These soils formed in stratified loamy sediment.

In a representative profile the surface layer is brown fine sandy loam about 5 inches thick. The next layer is 9 inches of strong-brown sandy clay loam mottled with yellowish red. The next layer is 7 inches of strong-brown clay loam mottled with gray and yellowish red. The next layer is 17 inches of light-gray clay loam mottled with red and yellowish brown. It contains cracks and channels filled with uncoated sand. Below this to a depth of 90 inches is light-gray clay mottled with red and yellowish brown. It has a few cracks filled with uncoated sand (fig. 7).

Kullit soils are moderately well drained. Permeability is moderately slow, and available water capacity is medium. These soils have a high potential as pastureland and woodland and a medium potential as cropland.

Representative profile of Kullit fine sandy loam in an area of Kullit-Addielou complex, 1 to 3 percent slopes, 7 miles north of Clarksville on Texas Highway No. 37, 1 mile east on county road, 100 feet south of county road, in pine plantation:

Ap—0 to 5 inches, brown (10YR 5/3) fine sandy loam; weak, medium, granular structure; slightly hard, very friable; common roots; slightly acid; clear, smooth boundary.

B21t—5 to 14 inches, strong-brown (7.5YR 5/6) sandy clay loam; common, fine, distinct, yellowish-red (5YR 4/8) mottles; weak, medium, subangular blocky structure; hard, friable; many fine roots; few pores and grains of sand bridged with clay; very strongly acid; clear, wavy boundary.

B22t—14 to 21 inches, strong-brown (7.5YR 5/6) clay loam; common, fine and medium, distinct, gray (10YR 6/1) mottles and common, fine, prominent, yellowish-red (5YR 4/8) mottles; weak, medium, subangular blocky structure; hard, friable; continuous clay films; very strongly acid; gradual, wavy boundary.

B23t—21 to 38 inches, light-gray (10YR 6/1) clay loam; common, fine and medium, prominent, red (2.5YR 4/8) mottles and common, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; very hard, friable; cracks and root channels filled with uncoated grains of sand; few concretions of iron; continuous clay films; very strongly acid; gradual, wavy boundary.

B24t—38 to 46 inches, light-gray (10YR 6/1) clay; common, fine and medium, prominent, red (2.5YR 4/8) mottles and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; strong, medium and coarse, subangular blocky structure; extremely hard, very firm, plastic; few cracks filled with uncoated grains of sand; very strongly acid; gradual, wavy boundary.

B25t—46 to 90 inches, light-gray (10YR 6/1) clay; common, fine and medium, prominent, red (2.5YR 4/8) mottles and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; strong, coarse, blocky structure; extremely hard, very firm, plastic; many slickensides some of which intersect; few vertical cracks filled with uncoated sand; very strongly acid; gradual boundary.

The solum ranges from 60 to 100 inches in thickness.

The A horizon ranges from 5 to 18 inches in thickness. The Ap horizon is brown, grayish brown, or dark grayish brown. It is strongly acid to slightly acid. The A2 horizon is pale brown, brown, yellowish brown, or light yellowish brown. It is strongly acid to medium acid.

The B21t and B22t horizons range from 14 to 36 inches in thickness. They are strong brown or yellowish red and have mottles of red, gray, or yellowish red. They are very strongly acid to strongly acid. The B23t, B24t, and B25t horizons are gray, light gray, red, or mottled gray, light gray, red, and yellowish brown. They are clay, sandy clay, or clay loam that contains more than 35 percent clay. They are very strongly acid to strongly acid.

Kullit-Addielou complex, 1 to 3 percent slopes (KuB).—This complex is about 55 percent Kullit soils, 30 percent Addielou soils, and 15 percent less extensive soils. It is on upland or high terrace stream divides. Slopes average about 2 percent, and the surface is weakly con-

***Figure 7.*—Profile of Kullit fine sandy loam, 1 to 3 percent slopes. Uncoated sand grains (lighter colored material) are near the sharpshooter blade.**

vex. Areas are 5 to 500 acres but average about 100 acres.

This complex is characterized by areas of Kullit fine sandy loam from which circular mounds of Addielou soils protrude in a random pattern. The mounds are so small and the soil pattern so intricate that it was not practical to separate the soils at the scale used in mapping. The mounds are 1 to 3 feet high, 40 to 100 feet in diameter, and 80 to 150 feet apart.

The Addielou soils have a surface layer of fine sandy loam about 28 inches thick. The upper 8 inches is brown, and the lower 20 inches is light yellowish brown. The next layer is 20 inches of yellowish-brown sandy clay loam mottled with yellowish red. The next layer is 12 inches of mottled yellowish-brown, gray, and yellowish-red sandy clay loam that contains vertical streaks and pockets of uncoated sand. Below this to a depth of 90 inches is gray clay that is coarsely mottled with red and yellowish brown. It contains vertical streaks of uncoated sand.

Included with this complex in mapping are areas of Freestone soils along the lower side of mapped areas. Areas are 10 to 15 acres in size and make up 10 to 20 percent of some mapped areas. Also included are a few areas of Annona soils in low spots. Areas are 5 to 10 acres in size and make up 5 to 10 percent of some mapped areas. There are a few areas of Bernaldo soils on small knolls. Areas are 10 to 15 acres in size and make up about 20 percent of some mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 70 percent of the acreage is used for pasture, 20 percent is wooded, and 10 percent is cultivated. Both soils in capability unit IIe–1; both soils in pasture and hayland group 8C; Kullit part in woodland suitability group 2w8, Addielou part in woodland suitability group 3o7.

Mabank Series

The Mabank series consists of deep, nearly level, acid, loamy soils on uplands. These soils formed in alkaline clayey sediment.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 6 inches thick. The next layer is 66 inches of clay. It is very dark gray mottled with dark grayish brown and grayish brown in the upper 33 inches; dark gray in the middle 10 inches; and grayish brown mottled with yellowish brown in the lower 23 inches. Below this to a depth of 90 inches is mottled light brownish-gray and yellowish-brown clay.

Mabank soils are somewhat poorly drained. Permeability is very slow, and available water capacity is medium. These soils have a medium potential as pastureland and cropland and a low potential as woodland.

Representative profile of Mabank fine sandy loam, 0 to 1 percent slopes, 0.25 mile west of junction of U.S. Highway No. 271 and Texas Highway No. 37, at Bogata, 200 feet south of U.S. Highway No. 271, in field:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) fine sandy loam; weak, fine, granular structure; hard, friable; many roots; medium acid; abrupt, wavy boundary.

B21tg—6 to 39 inches, very dark gray (10YR 3/1) clay; few, fine, faint, dark grayish-brown (2.5Y 4/2) and grayish-brown (10YR 5/2) mottles; moderate, fine and medium, blocky structure; extremely hard, very firm, plastic; few cracks filled with dark grayish-brown (10YR 4/2) loam; few roots; common clay films; few slickensides below a depth of 30 inches; few krotovinas filled with material from A horizon; slightly acid; gradual, smooth boundary.

B22tg—39 to 49 inches, dark-gray (10YR 4/1) clay; many, fine, faint, very dark gray (10YR 3/1) mottles; moderate, medium, blocky structure; extremely hard, very firm, plastic; few roots; few slickensides; continuous clay films; few krotovinas filled with dark grayish-brown (10YR 4/2) loam; few pockets of white neutral salts; calcareous; moderately alkaline; gradual, smooth boundary.

B23tg—49 to 72 inches, grayish-brown (10YR 5/2) clay; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, blocky structure; extremely hard, very firm, plastic; few roots; few slickensides; patchy clay films; few krotovinas filled with dark gray (10YR 4/1); few pockets of white neutral salts; few concretions of ferromanganese; calcareous; moderately alkaline; gradual, smooth boundary.

B24tg—72 to 90 inches, mottled light brownish-gray (2.5Y 6/2) and yellowish-brown (10YR 5/6) clay; weak, medium, blocky structure; very hard, very firm, slightly sticky; few pockets of white neutral salts; patchy clay films; calcareous; moderately alkaline.

The solum ranges from 60 to 100 inches in thickness.

The A horizon ranges from 4 to 11 inches in thickness. It is dark grayish brown, gray, grayish brown, very dark gray, or light brownish gray. It is medium acid to neutral.

The B21tg horizon is dark gray or very dark gray clay or silty clay. In some profiles it has mottles of dark yellowish brown, dark grayish brown, yellowish brown, grayish brown, dark grayish brown, or brown. It is medium acid to mildly alkaline. The lower part of the B2tg horizon is very dark gray, dark gray, grayish brown, and gray and has mottles of yellowish brown, very dark gray, dark gray, brownish yellow, or light yellowish brown. It is neutral to moderately alkaline.

Mabank fine sandy loam, 0 to 1 percent slopes (MaA).—This nearly level soil is on ridgetops and flats next to drainageways on uplands. Slopes average about 0.5 percent. Areas are oblong or long and narrow. They are 10 to 500 acres but average about 30 acres.

Included with this soil in mapping are small areas of Burleson soils on ridgetops. These areas are 3 to 8 acres in size and make up 10 to 15 percent of some mapped areas. Also included are a few areas of Panola soils in poorly drained positions. These areas are 6 to 12 acres in size and make up 15 to 20 percent of some mapped areas. There are also a few gently sloping areas of Deport soils, 3 to 10 acres in size, that make up 10 to 15 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 65 percent of the acreage is used for pasture, and 35 percent is cultivated. Capability unit IIIw–1; pasture and hayland group 8A; woodland suitability group not assigned.

McKamie Series

The McKamie series consists of deep, gently sloping to strongly sloping, loamy, acid soils on terraces. These soils formed in stratified beds of loamy and clayey sediment.

In a representative profile the surface layer is loam

about 9 inches thick. It is dark brown in the upper 6 inches and brown in the lower 3 inches. The next layer is 27 inches of red clay. The underlying material to a depth of 85 inches is reddish-brown stratified loam, silty clay loam, and clay.

McKamie soils are well drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and woodland and a low potential as cropland.

Representative profile of McKamie loam, 1 to 5 percent slopes, north of Clarksville on Texas Highway No. 37 to junction of Texas Highway No. 37 and Farm Road No. 195, 0.5 mile west on Farm Road No. 195, 50 feet north of road, in pasture:

Ap—0 to 6 inches, dark-brown (10YR 4/3) loam; weak, fine, granular structure; slightly hard, very friable; few roots; slightly acid; clear, smooth boundary.

A2—6 to 9 inches, brown (7.5YR 5/4) loam; weak, fine, granular structure; slightly hard, very friable; strongly acid; abrupt, smooth boundary.

B2t—9 to 36 inches, red (2.5YR 4/8) clay; few, fine, faint, strong-brown (7.5YR 5/8) mottles; moderate, medium, subangular blocky structure; very hard, very firm, very plastic; many clay films; few slickensides; very strongly acid; gradual, smooth boundary.

IIC—36 to 65 inches, 3- to 6-inch strata of reddish-brown (5YR 4/5) loam, silty clay loam, and reddish-brown (5YR 4/3) clay; massive; neutral.

The solum ranges from 36 to 50 inches in thickness.

The A horizon ranges from 3 to 9 inches in thickness. It is dark brown, brown, or dark grayish brown. It is strongly acid to slightly acid.

The Bt horizon is red, reddish brown, dark red, dark reddish brown, or yellowish red. It is sandy clay or clay that contains 45 to 60 percent clay. It is very strongly acid to medium acid.

The IIC horizon is red, reddish brown, or dark red. It is stratified fine sandy loam, silt loam, sandy clay loam, clay loam, silty clay loam, or clay. It is medium acid to mildly alkaline.

McKamie loam, 1 to 5 percent slopes (McC).—This gently sloping soil is on high terraces. Slopes average about 3 percent, and the surface is convex. Areas are long and narrow. They are 5 to 100 acres but average about 20 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Whakana soils, on higher elevations. These areas are 2 to 8 acres in size, and make up 5 to 10 percent of some mapped areas. Also included are areas of McKamie soils, on lower elevations, that have slopes of 5 to 12 percent. These areas are 5 to 10 acres in size and make up 10 to 15 percent of some mapped areas. There are also a few areas of Wrightsville soils in poorly drained areas around heads of streams. These areas are 3 to 8 acres in size and make up less than 5 percent of mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 35 percent of the acreage is used for pasture, 60 percent is wooded, and 5 percent is cultivated. Capability unit IVe–1; pasture and hayland group 8A; woodland suitability group 3c2.

McKamie loam, 5 to 12 percent slopes (McE).—This sloping to strongly sloping soil is on side slopes along streams on high terraces. Slopes average about 10 percent, and the surface is convex. Areas are long and narrow. They are 10 to 300 acres but average about 80 acres.

The surface layer is dark grayish-brown loam about 7 inches thick. The next layer is 29 inches of dark-red clay. Below this to a depth of about 60 inches is red, interbedded clay loam, silt loam, and clay.

Included with this soil in mapping are areas of McKamie soils, 3 to 5 percent slopes, around the heads of drainageways. Areas are 3 to 5 acres in size and make up 5 to 10 percent of some mapped areas. Also included are areas of Whakana soils on the upper part of mapped areas. These areas are 5 to 10 acres in size and make up 10 to 15 percent of some mapped areas.

Runoff is rapid. The hazard of erosion is severe.

About 20 percent of the acreage is used for pasture, and 80 percent is wooded. Capability unit VIe–1; pasture and hayland group 8B, woodland suitability group 3c2.

Morse Series

The Morse series consists of deep, gently sloping to sloping, clayey, alkaline soils on terraces. These soils formed in clayey sediment.

In a representative profile the surface layer is clay about 12 inches thick. It is dark reddish brown in the upper 3 inches and reddish brown in the lower 9 inches and contains a few concretions of calcium carbonate. The next layer to a depth of 84 inches is a red clay that contains a few pockets of loamy material.

Morse soils are well drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and a low potential as cropland and woodland.

Representative profile of Morse clay, 3 to 8 percent slopes, eroded, about 1 mile east of Clarksville on U.S. Highway No. 82, 17.1 miles east on Farm Road No. 114, 2.25 miles north on county road to low ridgetop, 0.3 mile northwest through pasture:

A11—0 to 3 inches, dark reddish-brown (5YR 3/4) clay; weak, medium, granular structure; very hard, very firm, plastic; few concretions of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

A12—3 to 12 inches, reddish-brown (5YR 4/4) clay; moderate, medium, blocky structure parting to moderate, fine, blocky; extremely hard, very firm, very plastic; few slickensides; few concretions of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

AC1—12 to 55 inches, red (2.5YR 4/6) clay; many coarse parallelepipeds, parting to moderate, fine, blocky structure with shiny pressure faces; extremely hard, extremely firm, very plastic; many intersecting slickensides as much as 6 inches across; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

AC2—55 to 84 inches, red (2.5YR 4/6) clay; weak, medium, blocky structure; extremely hard, extremely firm, very plastic; common intersecting slickensides; few small pockets of loamy material; calcareous; moderately alkaline.

The profile is 40 to 60 percent clay. It has common to many intersecting slickensides. Most areas have gilgai relief, with a maximum difference in elevation of about 4 inches between microridges and microvalleys.

The A horizon ranges in thickness from 2 inches in microridges to about 12 inches in microvalleys. It is dark reddish brown, reddish brown, or dark brown.

The AC horizon is red, reddish brown, or yellowish red. Most profiles have a few concretions of calcium carbonate.

Morse clay, 3 to 8 percent slopes, eroded (MoD2).—This gently sloping to sloping soil is on side slopes around drainageways on terraces. Slopes average about 6 percent, and the surface is convex. Areas are long and narrow. They are 10 to 200 acres but average about 20 acres. They have U-shaped gullies that are 4 to 6 feet across, 2 to 5 feet deep, and 150 to 300 feet apart. Most of them cannot be crossed with normal tillage implements.

Included with this soil in mapping are areas of McKamie soils, near ridgetops. The areas are 3 to 5 acres in size and make up 5 to 10 percent of some mapped areas.

Runoff is rapid. The hazard of erosion is severe.

All of the acreage is used for pasture. Capability unit VIe–2; pasture and hayland group 7B; woodland suitability group not assigned.

Muldrow Series

The Muldrow series consists of deep, nearly level, loamy, acid soils on terraces. These soils formed in clayey alluvial material.

In a representative profile the surface layer is very dark grayish-brown silty clay loam about 10 inches thick. The next layer to a depth of 85 inches is clay. It is black in the upper 26 inches and dark gray mottled with reddish brown and dark brown in the lower 49 inches.

Muldrow soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. These soils have a high potential as pastureland, cropland, and woodland.

Representative profile of Muldrow silty clay loam, 17.9 miles north of Clarksville on Texas Highway No. 37, west on Farm Road No. 195 to Farm Road No. 410, about 6 miles north on Farm Road No. 410, 0.75 mile southwest through field:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) silty clay loam; moderate, medium and coarse, granular structure; hard, firm, slightly plastic; many roots; medium acid; abrupt, smooth boundary.

B21t—10 to 36 inches, black (10YR 2/1) clay; moderate, fine, blocky structure; hard, very firm, plastic; continuous clay films; few crayfish channels filled with grayish brown (10YR 5/2); very few roots below a depth of 20 inches; neutral; diffuse, smooth boundary.

B22t—36 to 50 inches, dark-gray (10YR 4/1) clay; common, fine, distinct, reddish-brown (5YR 4/4) mottles and few, fine, faint, dark-brown (7.5YR 4/4) mottles; moderate, fine, blocky structure; extremely hard, very firm, plastic; shiny faces on peds; few slickensides; neutral; diffuse, smooth boundary.

B3g—50 to 85 inches, dark-gray (10YR 4/1) clay; common, fine, distinct, reddish-brown (5YR 4/4) mottles and few, fine, faint, dark-brown (7.5YR 4/4) mottles; weak, medium, blocky structure; extremely hard, very firm, plastic; few concretions of calcium carbonate as much as 2 centimeters in diameter; continuous clay films or shiny pressure faces; few intersecting slickensides; calcareous; moderately alkaline.

The solum ranges from 48 inches to more than 90 inches in thickness.

The A horizon ranges from 10 to 15 inches in thickness. It is black, very dark gray, very dark grayish brown, very dark brown, or dark brown. It is clay loam or silty clay loam.

The Bt horizon is black, very dark gray, dark gray, gray, grayish brown, or very dark grayish brown. Most profiles have mottles of yellowish brown, reddish brown, dark brown, or light gray. The horizon is clay or silty clay and is slightly acid or neutral. The B3g horizon is brown, dark gray, or gray and has mottles of dark yellowish brown, yellowish brown, reddish brown, or brown in most profiles. It is clay loam, clay, or silty clay and is neutral to moderately alkaline.

Muldrow silty clay loam (Mu).—This nearly level soil is in drainageways on terraces. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is plane or weakly concave. Areas are long and narrow or broad and irregular in shape. They are 5 to 500 acres but average about 50 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Waskom soils in better drained areas of this Muldrow soil. These areas are 3 to 12 acres in size and make up 5 to 15 percent of some mapped areas. Also included are areas of Wrightsville soils in more elevated areas. These areas are 3 to 10 acres in size and make up 5 to 10 percent of some mapped areas. There are also a few better drained areas of Desha soils, 5 to 10 acres in size, that make up 8 to 12 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 40 percent of the acreage is used for pasture, 50 percent is wooded, and 10 percent is cultivated. Capability unit IIw–2; pasture and hayland group 1A; woodland suitability group 2w5.

Muldrow-Elysian complex (Mx).—This complex is about 60 percent Muldrow soils, 25 percent Elysian soils, and 15 percent less extensive soils. It is on nearly level terraces. Slopes are 0 to 1 percent but average about 0.5 percent. The surface is plane. Areas are irregular in shape. They are 30 to 400 acres but average about 100 acres.

This complex is characterized by broad areas of Muldrow silty clay loam from which circular mounds of Elysian soils protrude in a random pattern. The mounds are too small and the soil pattern too intricate to separate at the scale used in mapping. The mounds are 2 to 4 feet high, 50 to 125 feet in diameter, and 200 to 400 feet apart.

The Muldrow soil has a surface layer of dark-brown silty clay loam about 10 inches thick. The next layer is 45 inches of clay. It is very dark gray in the upper part, dark gray in the middle, and gray in the lower part. It has light-gray and brown mottles. Below this to a depth of 72 inches is gray clay loam mottled with yellowish brown.

The Elysian soil has the profile described as representative of the series.

Included with this complex in mapping are areas of Whakana soils that make up about 20 percent of the mounds. Also included are a few areas of Wrightsville soils, around the edges of some mapped areas, that make up less than 5 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 40 percent of the acreage is used for pasture, 50 percent is wooded, and 10 percent is cultivated. Both

soils in capability unit IIw–2; Muldrow part in pasture and hayland group 1A. Elysian part in pasture and hayland group 8C; Muldrow part in woodland suitability group 2w5, Elysian part in woodland suitability group 2o7.

Nahatche Series

The Nahatche series consists of deep, nearly level, loamy, acid soils on bottom lands. These soils formed in loamy alluvial sediment.

In a representative profile the surface layer is dark grayish-brown clay loam about 6 inches thick. The next layer is 44 inches of clay loam that has few to common mottles of yellowish brown. It is grayish brown in the upper 6 inches, dark grayish brown in the middle 5 inches, and grayish brown in the lower 33 inches. Below this to a depth of 72 inches is gray sandy clay loam mottled with yellowish brown.

Nahatche soils are somewhat poorly drained. Permeability is moderate, and available water capacity is medium. These soils have a high potential as pastureland and woodland and a low potential as cropland.

Representative profile of Nahatche soils, frequently flooded, east of Clarksville on U.S. Highway No. 82 to Annona, 2.4 miles south on Farm Road No. 44, 1.1 miles south on county road, 2,700 feet southeast through gate in pasture to flood plain of creek, 1,450 feet south, on flood plain:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) clay loam; common, fine, distinct, dark-brown (7.5YR 4/4) mottles; weak, fine, subangular blocky structure; very hard, firm; many roots; medium acid; clear, smooth boundary.

B21g—6 to 12 inches, grayish-brown (10YR 5/2) clay loam; common, fine, faint, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; hard, friable; few concretions of ferromanganese; many roots; medium acid; clear, smooth boundary.

B22g—12 to 17 inches, dark grayish-brown (10YR 4/2) clay loam; moderate, fine, subangular blocky structure; hard, friable; many roots; medium acid; clear, smooth boundary.

B23g—17 to 50 inches, grayish-brown (10YR 5/2) clay loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; hard, friable; few pockets and lenses of uncoated sand; few pockets of dark gray (10YR 4/1); strongly acid; gradual, smooth boundary.

B24g—50 to 72 inches, gray (10YR 5/1) sandy clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, blocky structure; hard, friable; few fine pockets of dark gray (10YR 4/1); medium acid.

The A horizon ranges from 6 to 10 inches in thickness. It is very dark grayish brown, dark grayish brown, brown, or grayish brown and has few to common, fine mottles of dark brown, dark gray, gray, dark yellowish brown, yellowish brown, or brown. It is loam, clay loam, sandy clay loam, or silty clay loam and is medium acid to neutral.

The B2g horizon is grayish brown, light gray, dark grayish brown, or gray and has mottles of light gray or yellowish brown. The upper part is loam, silty clay loam, sandy clay loam, or clay loam that contains 20 to 35 percent clay. A few profiles are clay below a depth of 40 inches.

Nahatche soils, frequently flooded (Na).—This mapping unit consists of Nahatche soils and of soils that are similar to Nahatche soils in use and management. It is nearly level and is on bottom lands. Slopes are 0 to 1 percent but average 0.5 percent. The surface is plane to weakly concave. Areas are long and narrow and parallel the streams. They are 10 to 1,000 acres but average about 165 acres. Floods cover 80 to 90 percent of the acreage 2 or 3 times a year for periods of 1 to 3 days, mainly during the growing season.

Included with these soils in mapping are areas of Gladewater soils in depressional areas. These areas are 5 to 20 acres in size and make up 8 to 25 percent of some mapped areas. Also included are a few areas of Thenas soils, 5 to 10 acres in size, that make up 5 to 15 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 40 percent of the acreage is used for pasture, and 60 percent is wooded. Capability unit Vw–1; pasture and hayland group 2C; woodland suitability group 1w6.

Oklared Series

The Oklared series consists of deep, nearly level, loamy, alkaline soils on bottom lands. These soils formed in Recent alluvial deposits.

In a representative profile the surface layer is reddish-brown fine sandy loam about 10 inches thick. The underlying material extends to a depth of 65 inches. The upper part is 5 inches of reddish-brown fine sandy loam, the next part is 10 inches of reddish-brown very fine sandy loam, and the lower part is stratified reddish-brown and light reddish-brown fine sandy loam.

Oklared soils are well drained. Permeability is moderately rapid, and available water capacity is medium. These soils have a medium potential as pastureland and a high potential as cropland and woodland.

Representative profile of Oklared fine sandy loam, 1 mile east of Clarksville on U.S. Highway No. 82, east on Farm Road No. 114 to English, 3.2 miles north on Farm Road No. 1699, 2.5 miles northeast on county road, 2.7 miles north on private road, 0.75 mile west on private road, 1 mile north on private road, 220 yards south of Red River:

Ap—0 to 10 inches, reddish-brown (5YR 5/4) fine sandy loam; weak, fine, granular structure; slightly hard, very friable; common fine roots; calcareous; moderately alkaline; clear, smooth boundary.

C1—10 to 15 inches, reddish-brown (5YR 5/4) fine sandy loam; massive; slightly hard, very friable; common roots; many thin strata of reddish-brown (5YR 4/4) loam and very fine sandy loam; calcareous; moderately alkaline; clear, smooth boundary.

C2—15 to 25 inches, reddish-brown (5YR 5/4) very fine sandy loam; massive; slightly hard, very friable; few fine roots; few strata as much as 2 inches thick; calcareous; moderately alkaline; clear, smooth boundary.

C3—25 to 65 inches, stratified, reddish-brown (5YR 4/4) and light reddish-brown (5YR 6/4) fine sandy loam; massive; slightly hard, friable; strata are 4 to 10 inches thick and are finely stratified within themselves; calcareous; moderately alkaline.

The A horizon ranges from 6 to 16 inches in thickness. It is reddish brown, dark brown, brown, or dark reddish brown. It is fine sandy loam, silt loam, or silty clay loam.

The C horizon is yellowish red, reddish brown, or light reddish brown. It is stratified fine sandy loam, loam, or very fine sandy loam.

Oklared fine sandy loam (Of).—This nearly level soil is on bottom lands. Slopes are 0 to 1 percent but average about 0.5 percent. The surface is plane to weakly convex. Areas are irregular in shape. They are 50 to 500 acres but average about 125 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Oklared silty clay loam in minor depressions. The areas are 5 to 10 acres in size and make up 5 to 10 percent of some mapped areas. Also included are a few areas of Redlake soils in depressions. The areas are 3 to 8 acres in size and make up less than 5 percent of mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 50 percent of the acreage is used for pasture, 30 percent is wooded, and 20 percent is cultivated. Capability unit IIw–4; pasture and hayland group 2A; woodland suitability group 2o4.

Oklared silty clay loam (Ok).—This nearly level soil is on bottom lands. Slopes are 0 to 1 percent but average about 0.5 percent. The surface is plane to weakly concave. Areas are irregular in shape. They are 10 to 300 acres but average about 55 acres.

The surface layer is dark reddish-brown silty clay loam about 8 inches thick. The underlying material to a depth of about 65 inches is stratified with layers of reddish-brown fine sandy loam, very fine sandy loam, and loam.

Included with this soil in mapping are slightly higher ridges of Oklared fine sandy loam, 3 to 10 acres in size, that make up 5 to 15 percent of some mapped areas. Also included are small areas of Redlake soils, 3 to 5 acres in size, that make up less than 10 percent of mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 30 percent of the acreage is used for pasture, 60 percent is wooded, and 10 percent is cultivated. Capability unit IIw–4; pasture and hayland group 2A; woodland suitability group 2o4.

Panola Series

The Panola series consists of deep, nearly level, clayey, acid soils on uplands. These soils formed in clayey sediment.

In a representative profile the surface layer is very dark grayish-brown silty clay about 5 inches thick. The next layer is 37 inches of grayish-brown clay mottled with dark yellowish brown and yellowish brown. Below this to a depth of 83 inches is grayish-brown clay mottled with gray.

Panola soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and cropland and a low potential as woodland.

Representative profile of Panola silty clay, south of Clarksville on Farm Road No. 910 to Cuthand, east on Farm Road No. 1487 to end of highway, 3 miles south on county road, 1.9 miles east on private road, 300 yards south of private road, on logging road:

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) silty clay; weak, fine, granular and subangular blocky structure; very hard, firm; partly decomposed deciduous litter; strongly acid; clean, wavy boundary.

B21g—5 to 9 inches, grayish-brown (10YR 5/2) clay; common, medium and large, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; moderate, fine, blocky structure; very hard, firm; very strongly acid; gradual, wavy boundary.

B22tg—9 to 16 inches, grayish-brown (10YR 5/2) clay; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, blocky structure; extremely hard, very firm; shiny faces on peds; strongly acid; gradual, wavy boundary.

B23tg—16 to 42 inches, grayish-brown (10YR 5/2) clay; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, blocky structure; extremely hard, very firm; many clay films; shiny faces on peds; slickensides as much as 6 inches across; few concretions of ferromanganese; medium acid; gradual, wavy boundary.

B24tg—42 to 83 inches, grayish-brown (10YR 5/2) clay; weak, coarse, blocky structure; extremely hard, very firm; few cracks filled with gray (10YR 6/1); few roots in cracks; fewer slickensides than in horizon above; crayfish holes about 1 inch in diameter extend from the bottom of the A1 horizon into this horizon; medium acid.

The solum is more than 70 inches thick.

The A1 horizon ranges from 5 to 9 inches in thickness. It is grayish brown, dark brown, or very dark gray and has mottles of yellowish brown or brownish yellow. It is strongly acid to medium acid.

The Bt horizon is silty clay or clay. The B21tg horizon ranges from 4 to 15 inches in thickness. It is dark grayish brown or grayish brown and has mottles of yellow, brown, red, or gray. It is very strongly acid to medium acid. The B22tg horizon ranges from 4 to 10 inches in thickness. It is grayish brown, dark grayish brown, or light brownish gray and has mottles of yellow, brown, red, or gray. It is strongly acid to slightly acid. The lower part of the Btg horizon is dark gray, gray, grayish brown, or light brownish gray and has mottles of yellow, brown, red, or gray. It is medium acid to mildly alkaline.

Panola silty clay (Pa).—This nearly level soil is on uplands. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is plane to weakly concave. Areas are irregular in shape. They are 10 to 500 acres but average about 115 acres.

Included with this soil in mapping are areas of Wrightsville soils around edges of mapped areas. The areas are 10 to 20 acres in size and make up 10 to 20 percent of mapped areas. Also included are a few long, narrow areas of Woodtell soils along drainageways. The areas are 5 to 10 acres in size and make up 5 to 10 percent of some mapped areas. There are also a few convex ridges of Annona soils, 5 to 10 acres in size, that make up 5 to 10 percent of mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 25 percent of the acreage is used for pasture, 65 percent is wooded, and 10 percent is cultivated. Capability unit IVw–1; pasture and hayland group 8E; woodland suitability group not assigned.

Redlake Series

The Redlake series consists of deep, nearly level, clayey, alkaline soils on bottom lands. In some places loamy overwash material is on the surface. These soils formed in clayey alluvial sediment.

In a representative profile the surface layer is dark reddish-brown clay about 9 inches thick. The next layer is 9 inches of reddish-brown clay. The next layer is 22 inches of dark reddish-brown clay mottled with reddish

brown. The next layer is 15 inches of yellowish-red clay loam mottled with very dark gray. The underlying material to a depth of 65 inches is reddish-brown loam.

Redlake soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and woodland and a high potential as cropland.

Representative profile of Redlake clay, about 22 miles north-northwest of Clarksville to Kiomatia, 1.5 miles north of Kiomatia on Farm Road No. 410, 500 feet west, in pasture:

Ap—0 to 9 inches, dark reddish-brown (5YR 3/4) clay; moderate, fine, granular and subangular blocky structure; very hard, firm, plastic; many roots; calcareous; moderately alkaline; gradual, smooth boundary.

B21—9 to 18 inches, reddish-brown (5YR 4/3) clay; moderate, fine, blocky structure; very hard, firm, plastic; shiny faces on peds; calcareous; moderately alkaline; gradual, smooth boundary.

B22—18 to 40 inches, dark reddish-brown (5YR 3/4) clay; few, fine, faint, reddish-brown (5YR 5/3) mottles; moderate, fine, blocky structure; very hard, firm, plastic; few slickensides; calcareous; moderately alkine; gradual, smooth boundary.

B23—40 to 55 inches, yellowish-red (5YR 4/6) clay loam; few, fine, distinct, very dark gray (5YR 3/1) mottles; moderate, fine, blocky structure; hard, friable; calcareous; moderately alkaline; clear, wavy boundary.

IIC—55 to 65 inches, reddish-brown (5YR 5/4) loam; massive; hard, friable; calcareous; moderately alkaline.

The solum ranges from 30 to 60 inches in thickness.

The A horizon ranges from 5 to 10 inches in thickness. It is dark reddish-gray, reddish-brown, or dark reddish-brown silty clay or very fine sandy loam.

The B2 horizon is reddish brown, yellowish red, or dark reddish brown. The upper part of the B2 horizon is 40 to 60 percent clay. Slickensides occur in most profiles, but they do not intersect.

The C horizon is similar to the B2 horizon in color. It is normally stratified with fine sandy loam, silt loam, clay loam, or clay.

Redlake clay (Rc).—This nearly level soil is on bottom lands that parallel the river and sloughs. Slopes are 0 to 1 percent but average about 0.5 percent. The surface is plane to weakly concave. Areas are long and narrow. They are 25 to 300 acres but average about 65 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Roebuck soils in depressional drainageways. The areas are 10 to 15 acres in size and make up 10 to 20 percent of some mapped areas. Also included are areas of Redlake soils that have a loamy surface layer. They are on slightly elevated positions, are 5 to 10 acres in size, and make up 5 to 10 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 51 percent of the acreage is used for pasture, 29 percent is wooded, and 20 percent is cultivated. Capability unit IIIw–2; pasture and hayland group 1A; woodland suitability group 3w6.

Redlake soils (Rd).—These nearly level soils are on bottom lands that parallel the river. Slopes are 0 to 1 percent but average about 0.5 percent. The surface is plane to weakly convex. Areas are 5 to 500 acres but average about 85 acres.

Redlake soils have a thin layer of varying texture deposited on the original clayey surface layer. The variation of thickness and texture is not uniform in size or occurrence.

The surface layer is reddish-brown very fine sandy loam about 10 inches thick. The next layer is 32 inches of dark reddish-brown clay. The underlying material to a depth of about 60 inches is reddish-brown fine sandy loam.

Included with these soils in mapping are narrow depressions of Redlake clay, less than 5 acres in size, that make up 5 to 10 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 60 percent of the acreage is used for pasture, 10 percent is wooded, and 30 percent is cultivated. Capability unit IIIw–3; pasture and hayland group 2A; woodland suitability group 3w6.

Rodessa Series

The Rodessa series consists of deep, nearly level, loamy, acid soils on uplands and terraces. These soils formed in clayey sediment.

In a representative profile the surface layer is loam about 18 inches thick. The upper 8 inches is brown, and the lower 10 inches is light yellowish brown. The next layer, in sequence from the top, is 10 inches of light yellowish-brown loam, 3 inches of pale-brown loamy material surrounded by white loam, 5 inches of gray clay that is mottled with red and brown and has white loam coats on the clay particles, and 13 inches of dark reddish-brown clay mottled with dark reddish gray and dark red. Below this to a depth of 72 inches is dark-brown clay mottled with grayish brown and yellowish brown.

Rodessa soils are somewhat poorly drained. Permeability is very slow, and available water capacity is medium. These soils have a medium potential as pastureland, cropland, and woodland.

Rodessa soils in Red River County are mapped only in a complex with Wrightsville soils.

Representative profile of Rodessa loam, in an area of Wrightsville-Rodessa complex, 12.65 miles north of the courthouse in Clarksville to International Paper Company Road No. 32; 0.25 mile west on county road, 100 feet north of road, on mound:

A11—0 to 8 inches, brown (10YR 5/3) loam; many, coarse, faint, brown (10YR 4/3) mottles; moderate, fine, granular structure; slightly hard, very friable; upper 1 inch contains partly decomposed hardwood litter; many fine roots; few krotovinas filled with brown (10YR 4/3) loam; strongly acid; gradual, smooth boundary.

A12—8 to 18 inches, light yellowish-brown (10YR 6/4) loam; weak, fine, subangular blocky structure; slightly hard, very friable; few fine pores; many fine roots; few worm channels coated with clay; strongly acid; gradual, smooth boundary.

B1—18 to 28 inches, light yellowish-brown (10YR 6/4) loam; yellowish-brown (10YR 5/4) faces on peds; weak, medium, subangular blocky structure; slightly hard, very friable; common fine roots; few patchy clay films on faces of peds; very strongly acid; abrupt, wavy boundary.

A'2g&B—28 to 31 inches, white (10YR 8/2) loam (A'2 part) that extends through the horizon and surrounds peds of pale-brown (10YR 6/3) loamy material (B

part); common, medium, distinct, strong-brown (7.5YR 5/6) mottles and few, medium, faint, light brownish-gray (10YR 6/2) mottles; weak, fine, and medium, subangular blocky structure; slightly hard, very friable; few woody roots; strongly acid; abrupt, wavy boundary.

B21tg&A'2—31 to 36 inches, gray (10YR 5/1) clay (Bt part) and white (10YR 8/2) loam that coats the top and sides of peds (A'2 part); many, coarse, prominent, dark-red (2.5YR 3/6) mottles and common, medium, distinct, reddish-brown (5YR 4/4) mottles; strong, coarse, blocky structure; extremely hard, very firm; few pressure faces; few vertical cracks filled with gray (10YR 6/1) loam; few fine roots; very strongly acid; gradual, smooth boundary.

B22t—36 to 49 inches, dark reddish-brown (5YR 3/4) clay; common, medium, faint, dark reddish-gray (5YR 4/2) mottles and few, fine, distinct, dark-red (2.5YR 3/6) mottles; moderate, coarse, blocky structure; extremely hard, very firm; many clay films; common slickensides; light yellowish-brown (10YR 6/4) coatings of silt on faces of peds; very strongly acid; gradual, smooth boundary.

B23t—49 to 72 inches, dark-brown (7.5YR 4/4) clay; few, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/8) mottles; weak, coarse, blocky structure; extremely hard, very firm; few old cracks filled with light yellowish-brown (10YR 6/4) loam; few slickensides and pressure faces; slightly acid.

The solum ranges from 60 inches to more than 100 inches in thickness.

The A horizon is loam or fine sandy loam and is very strongly acid to slightly acid. The A11 horizon is dark grayish brown, brown, dark yellowish brown, or yellowish brown, or pale brown. The A12 and B1 horizons are light yellowish brown, very pale brown, yellowish brown, or pale brown. The A'2g&B horizon is white, light-gray, gray, light brownish-gray, or grayish brown loam or fine sandy loam. It is very strongly acid to medium acid. The horizon is 60 to 75 percent A'2 material.

The B21tg&A'2 horizon is gray, dark gray, light brownish gray, or grayish brown and has mottles of red, dark red, yellowish red, reddish brown, strong brown, or brown. The Bt part of this horizon is clay or clay loam that makes up 70 to 90 percent of the matrix. This horizon is very strongly acid to slightly acid. The B22t and B23t horizons are dark reddish brown, dark red, red, yellowish red, dark brown, or reddish brown. Mottles with chroma of 2 or less occur throughout these horizons, and mottles of yellowish brown occur in most profiles. These horizons are clay or clay loam and are very strongly acid to slightly acid. Few to many slickensides are present in the lower part, generally below a depth of 40 inches.

Roebuck Variant

The Roebuck variant consists of deep, nearly level, clayey, alkaline soils on bottom lands. These soils formed in recently deposited, clayey alluvium.

In a representative profile the surface layer is dark reddish-brown clay about 12 inches thick. The next layer is 22 inches of dark-red clay mottled with gray. The underlying material to a depth of 96 inches is reddish-brown clay mottled with gray.

Roebuck soils are poorly drained. They are saturated about 6 months each year. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and a high potential as cropland and woodland.

Representative profile of Roebuck clay, calcareous variant, about 22 miles north-northwest of Clarksville to Kiomatia, 1.5 miles north of Kiomatia on Farm Road No. 410, 1,800 feet north of private road and 500 feet west of Farm Road No. 410, in north end of depression:

Ap—0 to 12 inches, dark reddish-brown (5YR 3/2) clay that contains a few red (2.5YR 4/6) spots; weak, fine, granular and subangular blocky structure, very hard, firm, plastic; calcareous; moderately alkaline; gradual, smooth boundary.

B2—12 to 34 inches, dark-red (2.5YR 3/6) clay; few to common, fine, distinct, gray (5Y 5/1) mottles; weak, medium, blocky structure; very hard, firm, plastic; few slickensides less than 1 inch across; calcareous; moderately alkaline; gradual, smooth boundary.

C—34 to 96 inches, reddish-brown (5YR 4/4) clay; distinct gray (5Y 5/1) mottles; very hard, firm, plastic; few thin strata of yellowish-red (5YR 4/6) clay loam as much as 3 inches thick; few slickensides 0.5 inch to 1.5 inches across; calcareous; moderately alkaline; gradual boundary.

The A horizon ranges from 10 to 15 inches in thickness. It is dark reddish brown or dark brown.

The B2 horizon ranges from 15 to 30 inches in thickness. It is dark red, dark reddish brown, or dark brown. Distinct mottles of gray are above a depth of 20 inches.

The C horizon is reddish brown and has mottles of gray. Strata of silt loam and silty clay loam are common below a depth of 40 inches.

Roebuck clay, calcareous variant (Rf).—This nearly level soil is on bottom lands. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is concave. Areas are long, narrow, winding sloughs and depressions. They are 5 to 100 acres but average about 35 acres.

Included with this soil in mapping are areas of better drained Redlake soils, 3 to 20 acres in size, that make up 10 to 30 percent of some mapped areas.

Runoff is very slow. The hazard of erosion is slight.

About 10 percent of the acreage is cultivated, and 90 percent is wooded. Capability unit IIIw–2; pasture and hayland group 1A; woodland suitability group 2w6.

Rosalie Series

The Rosalie series consists of deep, gently sloping, sandy, acid soils on uplands. These soils formed in loamy sediment.

In a representative profile the surface layer is brown loamy fine sand 9 inches thick. The next layer is 22 inches of very pale brown loamy fine sand. This layer penetrates the next lower layer in streaks and tongues. The next layer is 15 inches of yellowish-brown sandy clay loam mottled with red, gray, and yellowish brown. The next layer is 28 inches of red sandy clay loam mottled with gray and yellowish brown. Below this to a depth of 100 inches is mottled red, gray, and yellowish-red sandy clay loam.

Rosalie soils are well drained. Permeability is moderate, and available water capacity is low. These soils have a medium potential as pastureland, cropland, and woodland.

Representative profile of Rosalie loamy fine sand, 2 to 5 percent slopes, south of Clarksville on Farm Road No. 909 to Rosalie, 500 feet north on county road, 2,300 feet west on county road, 400 feet north on county road, 50 feet east of road, in idle field:

Ap—0 to 9 inches, brown (10YR 5/3) loamy fine sand; weak, fine, granular structure; loose; common, fine, fibrous roots; very strongly acid; clear, smooth boundary.

A21—9 to 21 inches, very pale brown (10YR 7/3) loamy fine sand; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; single-grained; loose; few, fine, fibrous roots; few pebbles of quartz 2.5 to 7.5 centimeters in diameter; very strongly acid; clear, smooth boundary.

A22—21 to 31 inches, very pale brown (10YR 7/3) loamy fine sand; single-grained; loose; few, medium, distinct, yellowish-brown (10YR 5/6), brittle spots; few, medium, distinct, black (10YR 2/1) and dark yellowish-brown (10YR 4/4) segregations; few pebbles of quartz; very strongly acid; clear, irregular boundary.

B21t&A2—31 to 46 inches, yellowish-brown (10YR 5/6) sandy clay loam; few, fine, prominent, slightly brittle, red (2.5YR 5/6) mottles; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; hard, friable; gray (10YR 6/1) clay films surround some peds; red (2.5YR 5/6) is in the interior of the peds and is surrounded by yellowish brown (10YR 5/4); surfaces of prisms are gray (10YR 6/1); very pale brown (10YR 7/3) uncoated grains of sand and silt (A2 material) are on some vertical faces of peds and occupy about 10 to 15 percent of the horizontal cross section; very strongly acid; gradual, wavy boundary.

B22t—46 to 74 inches, red (2.5YR 4/6) sandy clay loam; weak, coarse, prismatic structure parting to weak, fine and medium, subangular blocky; very hard, friable; yellowish brown (10YR 5/8) surrounds the matrix and is surrounded by gray (10YR 6/1); some peds are coated with gray (10YR 5/1) clay films; extremely acid; gradual, wavy boundary.

B3—74 to 100 inches, mottled red (2.5YR 4/8), gray (10YR 6/1) and yellowish-red (5YR 5/6) sandy clay loam; weak, coarse, blocky structure; very hard, friable; extremely acid.

The solum ranges from 60 inches to more than 100 inches in thickness.

The A horizon is very strongly acid to medium acid. The Ap horizon is dark brown, brown, dark grayish brown, yellowish brown, or dark yellowish brown. The A2 horizon is light yellowish brown, yellowish brown, very pale brown, pale brown, and brown.

The Bt horizon is sandy clay loam or clay loam containing 20 to 30 percent clay. It is extremely acid or very strongly acid. The B21t&A2 horizon is yellowish brown, brownish yellow, brown, or strong brown. Some profiles have a few fine and medium mottles of red, yellowish red, and gray. This horizon is 5 to 20 percent grayish and silt A2 material. The B22t and B3 horizons are mottled with yellowish red, yellowish brown, brownish yellow, gray, light gray, grayish brown, strong brown, dark red, or red. They are sandy clay loam, clay loam, or loam and have few to common pockets or vertical streaks of uncoated sand.

Rosalie loamy fine sand, 2 to 5 percent slopes (RsC).—This gently sloping soil is on uplands. Slopes average about 3 percent, and the surface is convex. Areas are irregular in shape. They are 5 to 600 acres but average about 40 acres.

Included with this soil in mapping are areas of Kenney soils on higher elevations. The areas are 2 to 10 acres in size and make up 5 to 15 percent of some mapped areas. Also included are areas of Bernaldo soils, 5 to 10 acres in size, that make up 10 to 15 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 80 percent of the acreage is used for pasture, 10 percent is wooded, and 10 percent is cultivated (fig. 8). Capability unit IIIs–1; pasture and hayland group 9A; woodland suitability group 3s2.

Thenas Series

The Thenas series consists of deep, nearly level, loamy, acid soils on bottom lands. These soils formed in loamy alluvial sediment.

In a representative profile the surface layer is brown fine sandy loam about 8 inches thick. Below this is 6 inches of dark-brown very fine sandy loam mottled with light yellowish brown. The next layer is 13 inches of dark yellowish-brown loam mottled with gray. The next layer is 26 inches of pale-brown fine sandy loam mottled with dark yellowish brown and gray. The underlying material to a depth of 72 inches is light brownish-gray fine sandy loam mottled with dark yellowish brown.

Thenas soils are moderately well drained. Permeability is moderate, and available water capacity is high. These soils have a high potential as pastureland and woodland and a low potential as cropland.

Representative profile of Thenas fine sandy loam, frequently flooded, east of Clarksville on U.S. Highway No. 82 to Avery, 6.4 miles south of Avery on Farm Road No. 911, 1 mile northeast on county road, 700 feet east through pasture on private road to small creek, 100 feet south of private road, on east side of channel:

Ap—0 to 8 inches, brown (10YR 5/3) fine sandy loam; common, fine, faint, dark grayish-brown (10YR 4/2) mottles and few, coarse, faint, light yellowish-brown (10YR 6/4) mottles; weak, medium, granular structure; hard, friable; common fibrous roots; few concretions of ferromanganese; slightly acid; gradual smooth boundary.

A12—8 to 14 inches, dark-brown (10YR 4/3) very fine sandy loam; common, coarse, distinct, light yellowish-brown (10YR 6/4) mottles; weak, medium, granular structure; hard, friable; slightly acid; clear, smooth boundary.

B21—14 to 27 inches, dark yellowish-brown (10YR 4/4) loam; common, fine, distinct, gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; hard, very friable; medium acid; gradual, wavy boundary.

B22—27 to 53 inches, pale-brown (10YR 6/3) fine sandy loam; common, medium, distinct, gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; hard, very friable; few fine pores; medium acid; gradual, wavy boundary.

C—53 to 72 inches, light brownish-gray (10YR 6/2) fine sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; slightly hard, very friable; slightly acid.

The solum ranges from 50 to 70 inches in thickness.

The A horizon ranges from 6 to 15 inches in thickness. It is medium acid to neutral.

The B and C horizons are yellowish brown, brown, pale brown, light yellowish brown, or dark yellowish brown. Gray, light brownish gray, and dark grayish brown are dominant in places below a depth of 24 inches. The B horizon is fine sandy loam, very fine sandy loam, or loam. The C horizon ranges from fine sandy loam to clay loam. The B and C horizons are medium acid to neutral.

Thenas fine sandy loam, frequently flooded (Th).—This nearly level soil is on bottom lands parallel to streams. Slopes are 0 to 1 percent but average about 0.75 percent. The surface is plane to weakly concave. Areas are long and narrow. They are 10 to 35 acres but average about 40 acres. Floods cover about 90 per-

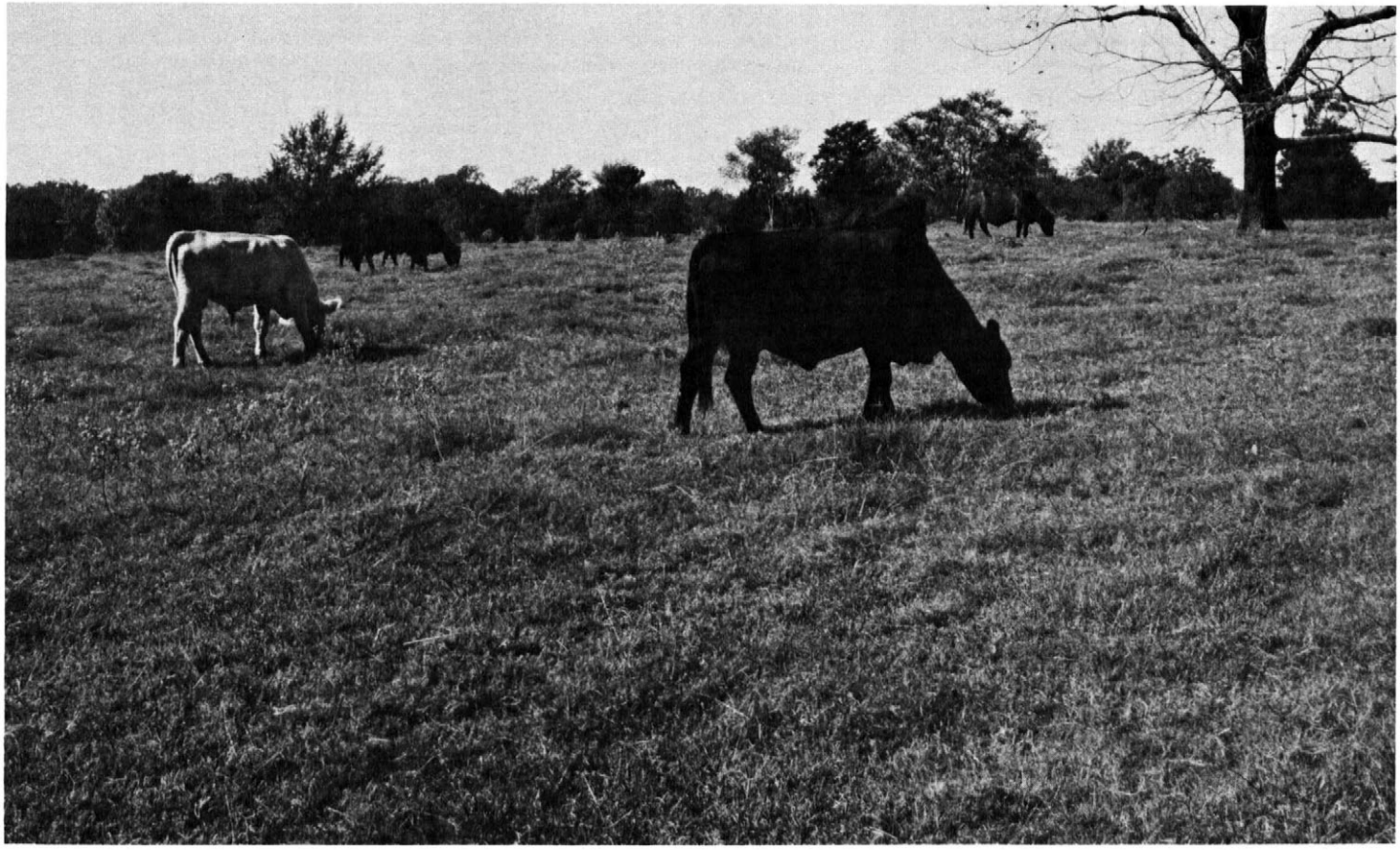


Figure 8.—**Cattle grazing common bermudagrass in an area of Rosalie loamy fine sand, 2 to 5 percent slopes.**

cent of this soil 2 to 4 times a year for periods of 8 to 24 hours.

Included with this soil in mapping are areas of similar soils that are browner. These areas are better drained, are 10 to 15 acres in size, and make up 10 to 15 percent of some mapped areas. Also included are areas of Nahatche soils in depressions. These areas are 5 to 10 acres in size and make up 5 to 10 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 30 percent of the acreage is used for pasture, and 70 percent is wooded. Capability unit Vw–1; pasture and hayland group 2A; woodland suitability group 1w8.

Trinity Series

The Trinity series consists of deep, nearly level, clayey, alkaline soils on bottom lands. These soils formed in clayey alluvial material.

In a representative profile the surface layer is black clay about 15 inches thick. The next layer is 15 inches of very dark gray clay. Below this to a depth of 64 inches is dark-gray clay.

Trinity soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. These soils have a high potential as pastureland and woodland. Where the hazard of flooding can be controlled, they have a high potential as cropland.

Representative profile of Trinity clay, frequently flooded, 8.4 miles southeast of Clarksville in pasture west of Kickapoo Creek, 1.9 miles east of Clarksville on U.S. Highway No. 82, 1.95 miles southeast on Farm Road 412, 1.2 miles east on county road, 1.5 miles southwest and 4.8 miles southeast on county road, 2,400 yards southeast:

A11—0 to 15 inches, black (10YR 2/1) clay; moderate, fine, granular structure; very hard, firm, plastic; calcareous; moderately alkaline; gradual, smooth boundary.

A12—15 to 30 inches, very dark gray (10YR 3/1) clay; moderate, fine, subangular blocky structure; very hard, firm, plastic; calcareous; moderately alkaline; gradual, smooth boundary.

A13—30 to 64 inches, dark-gray (10YR 4/1) clay; few, fine, distinct, olive (5Y 5/3) mottles; weak, fine, subangular blocky structure; very hard, very firm, plastic; few slickensides; calcareous; moderately alkaline.

This profile is clay or silty clay. The A horizon ranges from 28 inches to more than 60 inches in thickness. It is black, dark gray, or very dark gray and has common mottles of olive, dark yellowish brown, or brown.

Trinity clay (Tr).—This nearly level soil is on bottom lands that are protected by levees and other flood-control structures. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is plane to weakly concave. Areas are oblong. They are 20 to 300 acres but average about 60 acres.

The surface layer is black clay about 42 inches thick. The next layer to a depth of about 65 inches is dark-gray clay.

Included with this soil in mapping are areas of Kaufman soils in areas of mixed sediment. Areas are 10 to 15 acres in size and make up 5 to 15 percent of some mapped areas. Also included are areas of Gladewater soils in more poorly drained spots. Areas are 5 to 15 acres in size and make up 5 to 15 percent of some mapped areas.

Runoff is very slow. The hazard of erosion is slight.

About 70 percent of the acreage is used for pasture, 15 percent is wooded, and 15 percent is cultivated. Capability unit IIw–1; pasture and hayland group 1A; woodland suitability group 1w6.

Trinity clay, frequently flooded (Ts).—This nearly level soil is on bottom lands parallel to streams. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is plane to weakly concave. Areas are long and narrow. They are 20 to 600 acres but average about 80 acres. Most areas of this soil are flooded 1 to 3 times each year, for periods of 4 to 12 hours, during the growing season. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Kaufman soils, in areas of mixed sediment. These areas are 10 to 15 acres in size and make up 10 to 20 percent of some mapped areas. Also included are poorly drained spots of Gladewater soils, 5 to 15 acres in size, that make up 5 to 15 percent of some mapped areas.

About 70 percent of the acreage is used for pasture, and 30 percent is wooded. Capability unit Vw–3; pasture and hayland group 1A; woodland suitability group 1w6.

Varro Series

The Varro series consists of deep, nearly level, loamy, alkaline soils on bottom lands. These soils formed in loamy sediment.

In a representative profile the surface layer is about 7 inches of dark grayish-brown clay loam mottled with yellowish brown. The underlying material to a depth of 60 inches is grayish-brown clay loam that has light brownish-gray, dark grayish-brown, and very dark gray strata.

Varro soils are well drained. Permeability is moderate, and available water capacity is high. These soils have a medium potential as pastureland, a low potential as cropland, and a high potential as woodland.

Representative profile of Varro clay loam, south of Bogata on Texas Highway No. 37 to Farm Road No. 196, 4 miles west on Farm Road No. 196, 2.5 miles south on private levee road, 1,300 feet south of levee road, in woods:

A1—0 to 7 inches, dark grayish-brown (10YR 4/2) clay loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, subangular blocky and granular structure; hard, friable; few, fine roots and partly decomposed leaves; calcareous; moderately alkaline; abrupt, smooth boundary.

C—7 to 60 inches, grayish-brown (2.5Y 5/2) clay loam; thin strata of light brownish-gray (2.5Y 6/2) loam and slightly more clayey strata of dark grayish-brown (2.5Y 4/2) loam as much as 0.25 inch thick; few thin strata of very dark gray (10YR 3/1) silty clay below a depth of 40 inches; massive; hard, friable; few fine roots; calcareous; moderately alkaline.

The solum ranges from 10 to 40 inches in thickness. It is loam, very fine sandy loam, silty clay loam, or clay loam.

The A horizon is dark grayish brown to light brownish gray, brown to pale brown, dark yellowish brown, or olive brown to light yellowish brown. Below the A horizon, bedding planes are evident throughout.

The C horizon is grayish brown to light gray, brown to very pale brown, yellowish brown, light olive brown to light yellowish brown, or pale yellow. Thin black or very dark gray strata are in some profiles.

Varro clay loam (Va).—This nearly level soil is on bottom lands. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is plane to concave. Areas are long and narrow and parallel the river. This soil is flooded 3 to 6 times a year, for periods of 2 to 5 days, during the growing season. Water is concentrated on the soil by levees.

Included with this soil in mapping are areas of Trinity soils in depressional positions. These areas are 20 to 30 acres in size and make up about 10 percent of mapped areas.

Runoff is slow. The hazard of erosion is slight.

All of the acreage is wooded. Capability unit Vw–1; pasture and hayland group 2A; woodland suitability group 1w5.

Vesey Series

The Vesey series consists of deep, gently sloping to moderately steep, loamy, acid soils on terraces. These soils formed in loamy sediment.

In a representative profile the surface layer is fine sandy loam 24 inches thick. The upper 8 inches is dark brown, and the lower 16 inches is yellowish brown. The next layer is 28 inches of yellowish-red sandy clay loam. The next layer is 7 inches of reddish-yellow loam that contains uncoated grains of sand. Below this to a depth of 68 inches is red sandy loam mottled with light yellowish brown and reddish yellow.

Vesey soils are well drained. Permeability is moderate, and available water capacity is medium. These soils have a high potential as pastureland and a medium potential as cropland and woodland.

Representative profile of Vesey fine sandy loam, 3 to 8 percent slopes, 15 miles north of Detroit on Farm Road No. 410, 0.65 mile west on county road, 0.85 mile north on private road, 50 feet east of road:

A1—0 to 8 inches, dark-brown (10YR 4/3) fine sandy loam; moderate, fine, granular structure; very friable; common roots; slightly acid; gradual, smooth boundary.

A2—8 to 24 inches, yellowish-brown (10YR 5/4) fine sandy loam; single-grained; loose; few roots; medium acid; clear, smooth boundary.

B21t—24 to 42 inches, yellowish-red (5YR 4/6) sandy clay loam; moderate, coarse, subangular blocky structure; hard, friable; few roots; few fine pores; continuous thin clay films on faces of peds; medium acid; gradual, smooth boundary.

B22t—42 to 52 inches, yellowish-red (5YR 5/8) sandy clay loam; few, fine, distinct, red (2.5Y 4/6) mottles and few, fine, faint, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; hard, friable; few fine pores; discontinuous clay films on

faces of peds; few uncoated grains of sand; few pebbles of quartz 2 to 5 millimeters in diameter; slightly acid; gradual, smooth boundary.

B23t&A'2—52 to 59 inches, reddish-yellow (7.5YR 6/6) loam; few, fine, distinct, red (2.5YR 4/6) and light-gray (10YR 7/1) mottles; common light-gray (10YR 6/1) silt coatings 0.5 to 2 millimeters thick on faces of peds; weak, fine, subangular blocky structure; hard, friable; few fine pores; patchy clay films and grains of sand bridged with clay; about 5 percent pockets of uncoated grains of sand; medium acid; gradual, smooth boundary.

B3t—59 to 68 inches, red (10R 4/8) sandy loam; many, coarse, prominent, light yellowish-brown (10YR 6/4) mottles and few, fine, distinct, reddish yellow (7.5 YR 6/6) mottles; weak, medium, subangular blocky structure; slightly hard, very friable; most grains of sand bridged and coated with clay; few to common uncoated grains of sand; few iron-enriched concretions about 5 millimeters in diameter; strongly acid.

The solum ranges from 50 inches to more than 70 inches in thickness.

The A horizon ranges from 20 to 36 inches in thickness. It is neutral to medium acid. The Ap horizon is dark brown, brown, or yellowish brown. The A2 horizon is brown, light brown, strong brown, reddish yellow, yellowish brown, or brownish yellow.

The upper 20 inches of the Bt horizon is sandy clay loam or clay loam containing 18 to 30 percent clay. The B2t horizon is dark red, red, yellowish red, brown, strong brown, or reddish yellow and has mottles of brownish yellow, strong brown, yellowish brown, yellowish red, and red in some profiles. It is strongly acid to slightly acid. The B3t horizon is red, yellowish red, or pink. It is sandy loam, loam, fine sandy loam, or loamy fine sand and is strongly acid to neutral.

Vesey fine sandy loam, 3 to 8 percent slopes (VeD).—This gently sloping to sloping soil is on terraces. Slopes average about 4 percent, and the surface is convex. Areas are irregularly shaped ridges. They are 7 to 40 acres but average about 20 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of steep McKamie soils, 2 to 8 acres in size, that make up 10 to 20 percent of some mapped areas. Also included are a few areas of Whakana soils, 5 to 10 acres in size, that make up 15 to 25 percent of some mapped areas.

Runoff is slow. The hazard of erosion is moderate.

About 50 percent of the acreage is used for pasture, 35 percent is wooded, and 15 percent is cultivated. Capability unit IIIe–2; pasture and hayland group 8C; woodland suitability group 3o1.

Vesey fine sandy loam, 8 to 20 percent slopes (VeF).—This strongly sloping to moderately steep soil is on terraces. Slopes average about 14 percent, and the surface is convex. Areas are long and narrow. They are 5 to 100 acres but average about 40 acres.

The surface layer is fine sandy loam about 20 inches thick. It is brown in the upper 8 inches and light brown in the lower 12 inches. The next layer is 9 inches of red clay loam. The next layer is 23 inches of red sandy clay loam that has yellowish-red mottles. Below this to a depth of 84 inches is red loam that contains layers of yellowish-red and yellowish-brown sandy loam.

Included with this soil in mapping are bands of McKamie soils, near ridgetops. These areas are 5 to 10 acres in size and make up 10 to 15 percent of some mapped areas. Also included are areas of Whakana soils, 5 to 10 acres in size, that make up 10 to 20 percent of some mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 35 percent of the acreage is used for pasture, and 65 percent is wooded. Capability unit VIe–3; pasture and hayland group 8D; woodland suitability group 3o1.

Waskom Series

The Waskom series consists of deep, nearly level, loamy, acid soils on terraces. These soils formed in loamy alluvial sediment.

In a representative profile the surface layer is very dark grayish-brown loam about 15 inches thick. It is mottled with reddish brown in the lower 8 inches. The next layer is 17 inches of dark-brown clay loam mottled with reddish brown, dark grayish brown, and brown. The next layer is 20 inches of sandy clay loam mottled with brown, yellowish brown, strong brown, and grayish brown. Below this to a depth of 80 inches is sandy clay loam mottled with yellowish brown, grayish brown, and strong brown.

Waskom soils are moderately well drained. Permeability is moderately slow, and available water capacity is high. These soils have a high potential as pastureland, cropland, and woodland.

Representative profile of Waskom loam, 17.5 miles north of Clarksville on Texas Highway No. 37, 2 miles west on Farm Road No. 195, 11.5 miles northwest on Farm Road No. 410, 1,300 feet south of road, in field:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; hard, friable; many fine roots; slightly acid; clear, smooth boundary.

A12—7 to 15 inches, very dark grayish-brown (10YR 3/2) loam; few, fine, distinct, reddish-brown (5YR 5/4) mottles; moderate, fine, granular structure; hard, friable; common fine roots; few earthworm channels; neutral; gradual, smooth boundary.

B21t—15 to 32 inches, dark-brown (10YR 3/3) clay loam; few, fine, distinct, reddish-brown (5YR 5/4) mottles, common, fine, faint, dark grayish-brown mottles, and common, fine and medium, distinct, brown (7.5YR 4/4) mottles; moderate, medium and coarse, prismatic structure parting to weak, medium, subangular blocky; very hard, firm, slightly plastic; common fine roots; few fine pores; thin, patchy, very dark grayish-brown (10YR 3/2) clay films, mostly in voids; few, fine, brown concretions; neutral; gradual, smooth boundary.

B22t—32 to 52 inches, mottled brown (10YR 5/3), yellowish-brown (10YR 5/6), and grayish-brown (2.5Y 5/2) sandy clay loam; few, medium, faint, grayish-brown (10YR 5/2) mottles and few, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, coarse, prismatic structure parting to moderate, fine and medium, subangular blocky; very hard, firm, slightly plastic; few fine flakes of mica; neutral; gradual, smooth boundary.

B3—52 to 80 inches, mottled yellowish-brown (10YR 5/6), grayish-brown, (10YR 5/2) and grayish-brown (2.5Y 5/2) sandy clay loam; few, medium, distinct strong-brown (7.5YR 5/6) mottles; weak, coarse, blocky structure; very hard, firm, slightly plastic; few strong-brown concretions 2 to 4 millimeters in diameter that have black centers; neutral.

The solum ranges from 50 inches to more than 80 inches in thickness. The A horizon ranges from 10 to 20 inches in thickness. It is very dark brown, very dark grayish brown, dark brown, or dark reddish brown.

The B21t horizon is very dark grayish brown, dark brown, very dark brown, or dark reddish brown and has mottles of

dark grayish brown, grayish brown, brown, dark yellowish brown, or reddish brown. It is loam, clay loam, or silty clay loam and is slightly acid to mildly alkaline. The B22t horizon typically is mottled dark yellowish brown, brown, dark grayish brown, grayish brown, reddish brown, or yellowish brown. Mottles of yellowish brown, brown, grayish brown, strong brown, or yellowish red are also common. This horizon is loam, clay loam, silty clay loam, or sandy loam and is slightly acid to mildly alkaline. The B3 horizon is mottled grayish brown to light brownish gray, brown, strong brown, yellowish brown, red, and gray. It is loam, sandy clay loam, clay loam, or silty clay loam and is neutral to moderately alkaline.

Waskom loam (Wa).—This nearly level soil is on terraces. Slopes are 0 to 1 percent but average about 0.5 percent. The surface is plane to weakly convex. Areas are irregular in shape. They are 15 to 100 acres but average about 40 acres.

Included with this soil in mapping are areas of Hapludalfs, loamy, 2 to 10 acres in size, that make up 5 to 15 percent of some mapped areas. Also included are areas of Muldrow soils in somewhat poorly drained positions. These areas are 2 to 8 acres in size and make up about 5 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 25 percent of the acreage is used for pasture, and 75 percent is cultivated. Capability unit IIw–2; pasture and hayland group 2A; woodland suitability group 2w5.

Whakana Series

The Whakana series consists of deep, nearly level to sloping, loamy, acid soils on terraces. These soils formed in loamy alluvial sediment.

In a representative profile the surface layer is brown loam about 9 inches thick. The next layer is brown loam 5 inches thick. The next layer is 10 inches of yellowish-red clay loam mottled with red. It has pockets of strong-brown loamy sand. The next layer is 10 inches of brown clay loam mottled with red and dark reddish brown. Below this is 12 inches of dark-red loam that has coatings of clean sand. The next layer is 17 inches of red loam that contains common streaks of uncoated sand on vertical faces. Below this to a depth of 80 inches is yellowish-red sandy clay loam that has less uncoated sand (fig. 9).

Whakana soils are well drained. Permeability is moderate, and available water capacity is high. These soils have a high potential as pastureland and woodland and a medium potential as cropland.

Representative profile of Whakana loam, 3 to 8 percent slopes, 23 miles north-northwest of Clarksville, 1 mile south of Kanawha, 1,600 feet west of Farm Road No. 410:

Ap—0 to 9 inches, brown (7.5YR 4/4) loam; moderate, fine, granular structure; slightly hard, very friable; many fibrous roots; few worm casts; medium acid; clear, smooth boundary.

A2—9 to 14 inches, brown (7.5YR 5/4) loam; weak, fine, subangular blocky structure; slightly hard, very friable; many fine roots; common, fine, dark-brown (7.5YR 3/2) and black (7.5YR 2/6) concretions; few krotovinas; slightly acid; clear, irregular boundary.

B21t—14 to 24 inches, yellowish-red (5YR 4/6) clay loam; few, coarse, faint, red (2.5Y 4/6) mottles; moderate, fine, subangular blocky structure; hard, friable; common fine roots; few fine pores; patchy clay films on faces of peds; few, medium, strong-brown pockets of loamy sand (A2 material); slightly acid; diffuse, smooth boundary.

B22t—24 to 34 inches, brown (7.5YR 5/4) clay loam; about 20 percent has coarse, distinct, dark reddish-brown (2.5YR 3/4) mottles; weak, coarse, prismatic structure parting to moderate, fine, subangular blocky; very hard, friable; common fine roots; few fine voids; clay films on faces of some peds; few silt coatings on faces of other peds; few black segregations; about 15 percent distinct, light-brown, vertical streaks of loamy sand, 2 to 5 millimeters in

Figure 9.—**Profile of Whakana loam, 3 to 8 percent slopes. The light-colored material in the lower part of the profile is uncoated sand.**

diameter, on faces of prisms; strongly acid; clear, wavy boundary.

B23t—34 to 46 inches, dark-red (2.5YR 3/6) loam; weak, coarse, prismatic structure parting to weak, medium, blocky and subangular blocky; hard, slightly brittle; few fine roots confined along the faces of peds; few fine and medium voids, some lined with clay; thick clay films on faces of some peds; some faces of peds are coated with brown (7.5YR 5/4) loamy sand 2 to 10 millimeters thick; few black (N 2/0) concretions 1 to 3 millimeters in diameter; very strongly acid; clear, irregular boundary.

B24t&A'2—46 to 63 inches, red (2.5YR 4/6) loam; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; very hard, slightly brittle in 10 to 15 percent of the matrix; few fine roots in gray (10YR 6/1) zones; peds have red (2.5YR 4/6) sandy clay loam interiors and dark-red (2.5YR 3/6) clay coatings; faces of prisms coated with gray (10YR 6/1) sandy clay about 1 millimeter thick; 20 to 30 percent white (10YR 8/1) streaks and tongues of loamy sand (A'2 material), 2 to 5 centimeters and tapering to 5 to 10 millimeters; common vesicles lined with clay; very strongly acid; diffuse, irregular boundary.

B25t&A'2—63 to 80 inches, yellowish-red (5YR 4/6) sandy clay loam; many, coarse, faint, red (2.5YR 4/6) mottles; weak, medium, subangular blocky structure; very hard, friable; about 10 percent gray (10YR 6/1) loamy sand (A'2 material); common, patchy clay films; very strongly acid.

The solum ranges from 60 inches to more than 80 inches in thickness.

The A horizon ranges from 8 to 20 inches in thickness. The A1 horizon is very dark grayish brown, dark grayish brown, dark brown, brown, strong brown, or reddish brown. It is loam, fine sandy loam, loamy fine sand, or very fine sandy loam and is medium acid or slightly acid. The A2 horizon is brown, light yellowish brown, light brown, or strong brown. It is loamy fine sand, fine sandy loam, loam, or very fine sandy loam and is strongly acid to neutral.

The B2t horizon is reddish brown, red, dark red, yellowish red, dark reddish brown, brown, or strong brown and has few to common mottles of the same colors in most profiles. The B2t horizon is loam, sandy clay loam, or clay loam and is very strongly acid to slightly acid. The B2t&A'2 horizon is red, dark red, reddish brown, yellowish red, brown, or strong brown and is very strongly acid to medium acid. It is 5 to 30 percent coatings of silt and pockets and tongues of gray, light gray, and white, sandy A'2 material.

Whakana loam, 3 to 8 percent slopes (WhD).—This gently sloping to sloping soil is on terraces. Slopes average about 5 percent, and the surface is convex. Areas are irregular in shape. They are 6 to 200 acres but average about 35 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of McKamie soils along streams. These areas are 3 to 8 acres in size and make up 10 to 15 percent of some mapped areas. Also included are a few areas of Vesey soils on small knolls. These areas are 3 to 8 acres in size and make up 10 to 15 percent of some mapped areas. There are also areas of Wrightsville soils in ponded spots. These areas are 1 to 3 acres in size and make up 5 to 10 percent of some mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 45 percent of the acreage is used for pasture, 45 percent is wooded, and 10 percent is cultivated (fig. 10). Capability unit IIIe–2; pasture and hayland group 8C; woodland suitability group 2o7.

Whakana-Elysian complex, 0 to 1 percent slopes (WkA).—This complex is about 55 percent Whakana soils, 30 percent Elysian soils, and 15 percent Wrightsville and other soils. It is on nearly level terraces. Slopes average about 0.5 percent and are plane to weakly convex. Areas are irregular in shape. They are 5 to 150 acres but average about 45 acres.

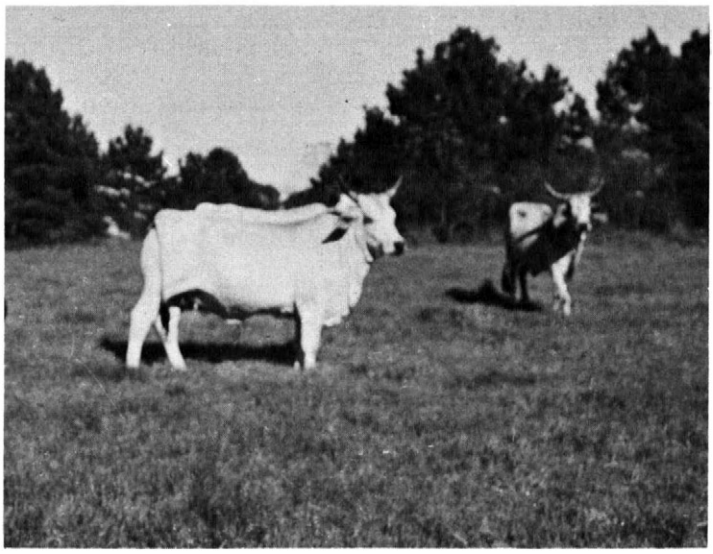


Figure 10.—**Cattle on Pensacola bahiagrass. The soil is Whakana loam, 3 to 8 percent slopes.**

This complex is characterized by areas of Whakana loam from which circular mounds of Elysian soils protrude in a random pattern. The mounds are so small and the soil pattern so intricate that it was not practical to separate the soils at the scale used in mapping. The mounds are 1 to 3 feet high, 50 to 100 feet in diameter, and 75 to 110 feet apart.

The Whakana soils have a surface layer of loam about 14 inches thick. The surface layer is dark grayish brown in the upper 4 inches, brown in the next 4 inches, and light yellowish brown in the lower 6 inches. The next layer is 21 inches of sandy clay loam. It is yellowish red in the upper 3 inches and strong brown in the lower 18 inches. The next layer is strong-brown loam that extends to a depth of 52 inches. This layer is mottled with brown, dark red, and yellowish red and contains streaks of uncoated sand. Below this to a depth of 90 inches is sandy loam. The upper 16 inches is yellowish red and contains streaks of uncoated sand, and the lower 22 inches is strong brown and contains strata of light gray.

The Elysian soils have a surface layer of brown fine sandy loam about 6 inches thick. The next layer is 13 inches of light yellowish-brown fine sandy loam. Below this to a depth of 90 inches is loam. The upper 13 inches is light yellowish brown and contains bodies and streaks of brown and yellowish brown; the next 41 inches is strong brown and contains penetrations of light yellowish-brown fine sandy loam; and the lower 17 inches is yellowish red.

The Wrightsville soils are in depressions that are 5 to 8 acres in size. They make up 10 to 15 percent of some mapped areas.

Runoff is slow. The hazard of erosion is slight.

About 61 percent of the acreage is used for pasture, 30 percent is wooded, and 9 percent is cultivated. Capability unit I–1; pasture and hayland group 8C; woodland suitability group 2o7.

Woodtell Series

The Woodtell series consists of deep, gently sloping to strongly sloping, loamy, acid soils on uplands. These soils formed in stratified loamy to clayey material and shale.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 6 inches thick. The next layer is 6 inches of yellowish-red clay mottled with light yellowish brown. The next layer is 17 inches of red clay mottled with gray and yellowish red. The next layer is 16 inches of yellowish-brown clay loam mottled with gray and red. The underlying material to a depth of 72 inches is stratified light olive-gray and gray sandy clay loam and yellowish-brown clay loam (fig. 11).

Woodtell soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils have a medium potential as pastureland and woodland and a low potential as cropland.

Representative profile of Woodtell fine sandy loam, 5 to 12 percent slopes, 8.4 miles south of intersection, in Clarksville, of U.S. Highway No. 82 and Farm Road No. 909, 1.9 miles east on private road, and 50 feet north, in pasture:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) fine sandy loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, granular structure; hard, friable; few roots; few worm casts; very strongly acid; clear, smooth boundary.

B21t—6 to 12 inches, yellowish-red (5YR 4/8) clay; few, fine, distinct, light yellowish-brown (10YR 6/4) streaks and mottles that increase in number with depth; moderate, fine, subangular blocky structure; very hard, very firm, plastic; common roots; continuous clay films; few krotovinas filled with material from A horizon; very strongly acid; gradual, wavy boundary.

B22t—12 to 29 inches, red (2.5YR 4/8) clay; many, medium, distinct, gray (10YR 6/1) mottles; few yellowish-red (5YR 4/8) streaks; weak, fine, blocky structure; very hard, very firm, plastic; continuous clay films; few slickensides; very strongly acid; gradual, smooth boundary.

B23t—29 to 45 inches, yellowish-brown (10YR 5/8) clay loam; many, medium, prominent, gray (10YR 6/1) mottles and few, coarse, prominent, red (2.5YR 4/8) mottles; weak, coarse, blocky structure; very hard, firm, plastic; few slickensides; few white (10YR 8/2) neutral salts; strongly acid; gradual, smooth boundary.

C—45 to 72 inches, stratified, light olive-gray (5Y 6/2) and gray (10YR 5/1) sandy clay loam and yellowish-brown (10YR 5/6) clay loam; medium, platy structure; hard, firm; few flattened roots; few black specks; slightly acid.

The solum ranges from 35 inches to about 65 inches in thickness.

The A horizon ranges from 4 to 9 inches in thickness. It is dark grayish brown to grayish brown, dark brown, or dark yellowish brown and has few fine mottles of strong brown. It is very strongly acid to slightly acid. The boundary between the A and Bt horizons ranges from abrupt to clear and from smooth to wavy, and the textural change is abrupt.

Figure 11.—**Profile of Woodtell fine sandy loam, 1 to 5 percent slopes.**

The B2t and B22t horizons are red or yellowish red and have few to common mottles in shades of gray, brown, yellow, and red. The number of gray mottles increases with depth. The horizons are 40 to 60 percent clay. They are very strongly acid or strongly acid. The B23t horizon is clay, clay loam, sandy clay, or sandy clay loam mottled with shades of gray or yellowish brown, red, and grayish brown. The clay content decreases 20 percent within 60 inches of the surface, or the solum is less than 60 inches thick. This horizon is very strongly acid or strongly acid.

The C horizon is stratified shale, shaly clay, sandy loam, loam, sandy clay loam, or clay loam mottled in shades of

gray, yellow, brown, or olive. It is very strongly acid to slightly acid.

Woodtell fine sandy loam, 1 to 5 percent slopes (WoC). —This gently sloping soil is on upland ridges. Slopes average about 3 percent, and the surface is convex. Areas are irregular in shape. They are 6 to 220 acres but average 45 acres.

The surface layer is dark-brown loam about 5 inches thick. The next layer is 17 inches of red and gray clay. The next layer is 18 inches of gray and yellowish-red clay and has a few mottles of red and yellowish brown. The next layer is 9 inches of gray clay that has a few strata of yellowish brown. The underlying material to a depth of 83 inches is gray shale that has strata of yellowish brown.

Included with this soil in mapping are areas of Annona soils, 5 to 15 acres in size, that make up 10 to 30 percent of some mapped areas. Also included are a few areas of Kullit soils, 5 to 10 acres in size, that make up 5 to 20 percent of some mapped areas. There are also areas of Wrightsville soils in depressions. These areas are 3 to 7 acres in size and make up 5 to 11 percent of some mapped areas.

Runoff is medium. The hazard of erosion is moderate.

About 30 percent of the acreage is used for pasture, 65 percent is wooded, and 5 percent is cultivated. Capability unit IIIe–1; pasture and hayland group 8A; woodland suitability group 4c2.

Woodtell fine sandy loam, 5 to 12 percent slopes (WoE). —This sloping to strongly sloping soil is on uplands. Slopes average about 10 percent, and the surface is convex. Areas are long and narrow. They are 10 to 400 acres but average about 45 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Woodtell soils that have slopes of less than 5 percent. These areas are at the heads of drainageways, are 5 to 10 acres in size, and make up 10 to 20 percent of some mapped areas. Also included are a few areas of Annona soils on small ridges. These areas are 3 to 8 acres in size and make up 5 to 10 percent of some mapped areas.

Runoff is rapid. The hazard of erosion is severe.

About 50 percent of the acreage is used for pasture, 48 percent is wooded, and 2 percent is cultivated. Capability unit VIe–1; pasture and hayland group 8B; woodland suitability group 4c2.

Wrightsville Series

The Wrightsville series consists of deep, nearly level, loamy, acid soils on uplands and terraces (fig. 12). These soils formed in clayey alluvial sediment.

Figure 12.—**Nearly level area of Wrightsville-Rodessa complex.**

In a representative profile the surface layer is very fine sandy loam about 11 inches thick. The upper 2 inches is dark grayish brown, and the lower 9 inches is light gray and is mottled with dark yellowish brown. The next layer is 40 inches of gray clay mottled with dark yellowish brown. The underlying material is 35 inches of light-gray clay mottled with dark yellowish brown and contains a few streaks of very dark gray.

Wrightsville soils are poorly drained. Permeability is very slow, and available water capacity is high. These soils have a low potential as pastureland and cropland and a medium potential as woodland.

Representative profile of Wrightsville very fine sandy loam in an area of Wrightsville-Rodessa complex, 12.5 miles north of the courthouse, in Clarksville, on Texas Highway No. 37, 0.65 mile east on International Paper Company Road, 125 feet south of road:

A1—0 to 2 inches, dark grayish-brown (10YR 4/2) very fine sandy loam; weak, fine, granular structure; hard, friable, very strongly acid; abrupt, smooth boundary.

A2g—2 to 11 inches, light-gray (10YR 6/1) very fine sandy loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; hard, friable; 5 to 10 percent uncoated sand; very strongly acid; abrupt, irregular boundary.

B21tg—11 to 21 inches, gray (10YR 5/1) clay; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, blocky structure; very hard, firm; 15 to 20 percent tongues of loam, 0.5 to 3 inches wide; uncoated sand on faces of some peds; few crayfish burrows filled with material from A2g horizon; very strongly acid; gradual, wavy boundary.

B22tg—21 to 40 inches, gray (10YR 5/1) clay; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, blocky structure; very hard, firm; very strongly acid; gradual, wavy boundary.

B23tg—40 to 51 inches, gray (10YR 5/1) clay; weak, coarse, blocky structure; very hard, firm; few fine masses of white (10YR 8/2) neutral salt; very strongly acid; gradual, wavy boundary.

C—51 to 86 inches, light-gray (10YR 6/1) clay; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles, and few very dark gray (10YR 3/1) streaks; massive; very hard, firm; strongly acid.

The solum ranges from 45 to 70 inches in thickness. It is very strongly acid to strongly acid.

The A1 horizon ranges from 2 to 4 inches in thickness. It is dark grayish-brown, brown, gray, or grayish-brown silt loam, loam, or very fine sandy loam. The A2 horizon ranges from 9 to 18 inches in thickness. It is gray, light-gray, or light brownish-gray silt loam or very fine sandy loam.

The B21tg horizon ranges from 5 to 30 inches in thickness. It is gray to light-gray clay or silty clay mottled with shades of yellow and brown. The lower part of the Btg horizon and the C horizon are gray to light gray and shades of yellow, brown, and olive. They are silty clay loam, silty clay, or clay.

Wrightsville-Rodessa complex (Wr).—This complex is about 70 percent Wrightsville soils, 20 percent Rodessa soils, and 10 percent other soils. It is on nearly level terraces and uplands. Slopes are 0 to 1 percent but average less than 0.5 percent. The surface is plane to weekly concave. Areas are irregular in shape. They are 15 to 3,000 acres but average about 300 acres.

This complex is characterized by large flats of Wrightsville loam from which circular mounds of Rodessa soils protrude in a random pattern. The mounds are so small and the soil pattern so intricate that it was not practical to separate the soils at the scale used in mapping (fig. 13). The mounds are 1.5 to 3 feet high, 35 to 70 feet in diameter, and 100 to 200 feet apart. A Rodessa soil in this complex has the profile described as representative of the series.

Included with this complex in mapping are areas of Panola soils in depressions. These areas are 10 to 30 acres in size and make up 10 to 20 percent of some mapped areas. Also included are areas of Annona soils on some mounds and slightly raised positions. These areas are 5 to 8 acres in size and make up 5 to 10 percent of some mapped areas. There are also a few areas of Woodtell soils on short slopes in drainageways. These areas are 4 to 8 acres in size and make up 5 to 10 percent of some mapped areas.

Runoff is very slow. The hazard of erosion is slight.

About 20 percent of the acreage is used for pasture, 78 percent is wooded, and 2 percent is cultivated. Both soils in capability unit IVw–1; Wrightsville part in pasture and hayland group 8E, Rodessa part in pasture and hayland group 8C; Wrightsville part in woodland suitability group 3w9, Rodessa part in woodland suitability group 3w8.

Use and Management of the Soils

The soils in Red River County are used mainly for crops, pasture, and hay. This section explains how the soils are used for these purposes and how the soils may be used for woodland, wildlife habitat, and recreation. The use of the soils for farm ponds, roads, buildings, and other engineering structures is also discussed.

Cropland [2]

About 11 percent of Red River County is used for crops. Most of this acreage consists of soils along the Red River in the northern part of the county and soils of the Blackland Prairie in the west-central part.

The principal crops are soybeans, cotton, grain sorghum, and small grain. Truck crops are grown on a very limited acreage of the more loamy and sandy soils of the county.

The chief management concerns in the cultivation of soils along the Red River are the maintenance of soil tilth and fertility. Management concerns of the Blackland Prairie soils and the forested uplands are the control of water erosion and the maintenance of soil fertility and tilth. In the following paragraphs the main practices used in management are discussed.

Use of crop residue.—Leaving a sufficient amount of crop residue on or near the surface of the soil helps to maintain the content of organic matter and to maintain soil tilth. This also helps to control water erosion and to conserve moisture.

Contour farming on terraces.—Using terraces on most soils that have slopes of more than about 1 percent and contour farming help to control water erosion.

[2] ALFRED L. PACE, agronomist, Soil Conservation Service, helped to prepare this section.

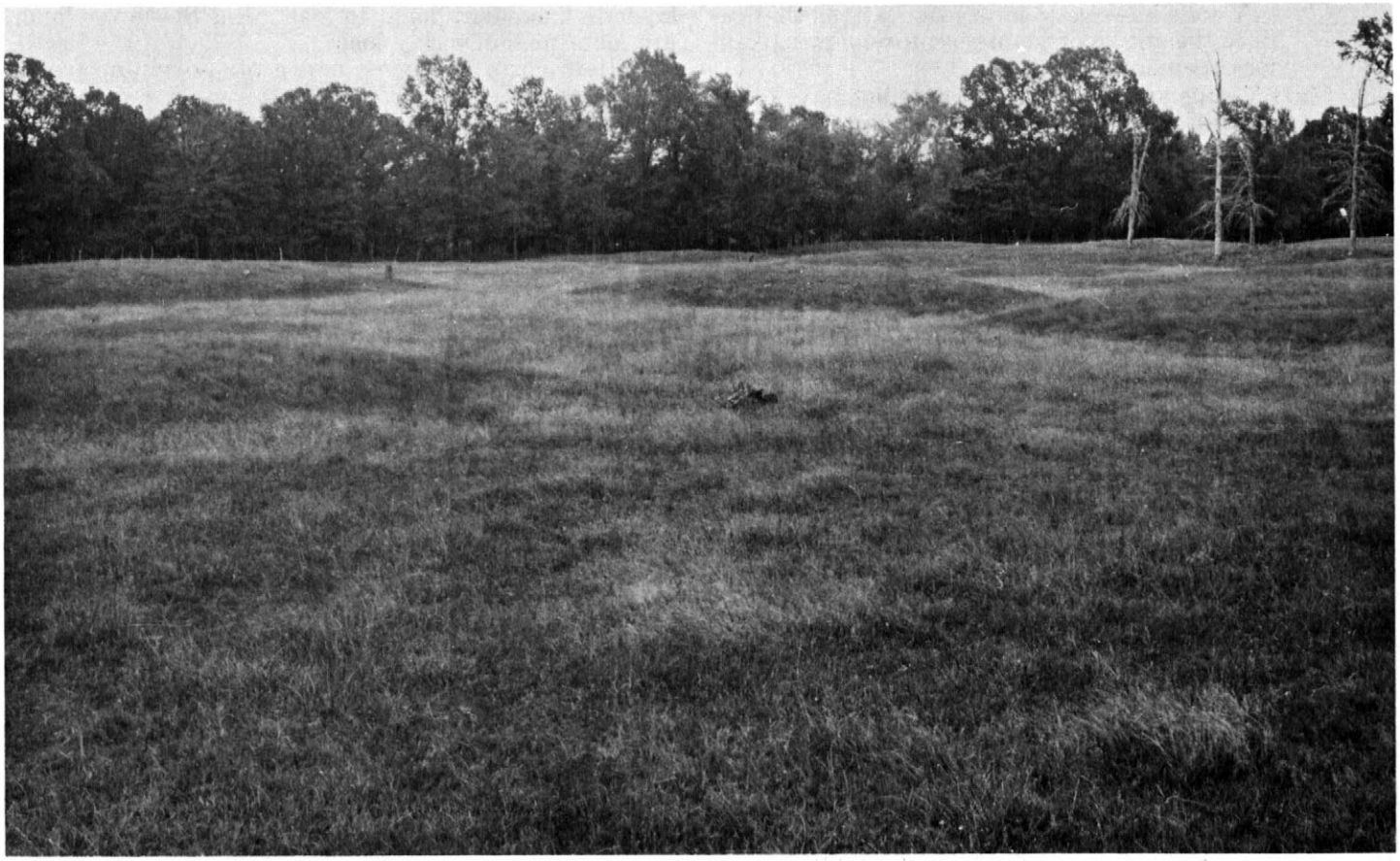


Figure 13.—Area of Wrightsville-Rodessa complex. The mounds are Rodessa loam, and the flat areas are Wrightsville very fine sandy loam.

Use of cover crops.—Planting crops that provide cover on the soil helps to protect against erosion between the time of harvest and the time of planting the next crop. Among crops suitable for most soils in the county are small grain, hairy vetch, crimson clover, and a mixture of annual legumes and grasses.

Maintenance of soil fertility.—In Red River County, crops respond to addition of fertilizer. Using other good soil management practices and applying a proper amount of fertilizer help to maintain fertility. Soils in different parts of the county vary widely in the need for different kinds and amounts of fertilizer. Therefore, a soil test should be made or the needs of a particular area of a soil known before fertilizer is applied. Information on soil testing and fertilizer application can be obtained from the Soil Conservation Service or the Agricultural Extension Service.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are arranged according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; it does not take into consideration possible but unlikely major reclamation projects; and it does not apply to rice, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for pasture, woodland, or engineering.

In the capability system, the kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use.

Class I soils have few limitations that restrict their use. (No subclasses)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, woodland, or wildlife habitat. (None in Red River County)

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes. (None in Red River County)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*. *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage) ; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about the management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–2 or IIIw–1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Red River County are described and suggestions for the use and management of the soils are given.

CAPABILITY UNIT I-1

In this unit are deep, nearly level, acid soils that are well drained and moderately permeable. The surface layer is fine sandy loam to loam, and the lower layers are loam to sandy clay loam.

Cotton, corn, soybeans, and grain sorghum are the main crops.

Maintaining fertility, the content of organic matter, and tilth are the main concerns in management. Returning crop residue to the soil and growing legumes and other cover crops and soil-improving crops help to meet these needs. These soils respond well to nitrogen and phosphorus fertilizers. In places lime is needed for some legumes.

CAPABILITY UNIT IIe-1

In this unit are deep, gently sloping, acid soils that are well drained to moderately well drained and moderately permeable to moderately slowly permeable. The surface layer is fine sandy loam, and the lower layers are sandy clay loam to loam.

Soybeans, grain sorghum, and corn are the main crops.

Maintaining fertility and the content of organic matter and controlling erosion are the main concerns in management. Returning crop residue to the soil and using contour farming and terraces help to meet these needs. These soils respond well to complete fertilizers. Lime is needed for most legumes.

CAPABILITY UNIT IIe-2

Houston Black clay, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, gently sloping, alkaline soil that is moderately well drained and very slowly permeable. The surface layer and lower layers are clay.

Soybeans, cotton, grain sorghum, and corn are the main crops. Root rot is a hazard if cotton is grown.

Maintaining fertility, the content of organic matter, and tilth and controlling erosion are the main concerns in management. Returning crop residue to the soil and growing deep-rooted crops help to improve permeability. Contour farming, terraces, and grassed waterways are needed to help control erosion. Nitrogen and phosphorus fertilizers are needed, but lime is not.

CAPABILITY UNIT IIe-3

Burleson clay, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, gently sloping, acid soil that is moderately well drained and very slowly permeable. The surface layer is clay, and the lower layers are clayey.

Cotton, soybeans, grain sorghum, and corn are the main crops.

Maintaining fertility, the content of organic matter, and tilth and controlling erosion are the main concerns in management. Returning crop residue to the soil and using contour farming, terraces, and grassed waterways help to control erosion. Nitrogen and phosphorus fertilizers are needed, but for most crops lime is not.

CAPABILITY UNIT IIw-1

In this unit are deep, nearly level, alkaline soils that are somewhat poorly drained and very slowly permeable. The surface layer and lower layers are clay.

Soybeans, cotton, and grain sorghum are the main crops.

Controlling excess water, maintaining tilth and the content of organic matter, and improving permeability are the main concerns in management. Returning crop residue to the soil and growing deep-rooted crops help to improve permeability. A drainage system helps to remove excess water. Nitrogen and phosphorus fertilizers are needed, but lime is not.

CAPABILITY UNIT IIw-2

In this unit are deep, nearly level, acid soils that are somewhat poorly drained to well drained and moderately permeable to very slowly permeable. The surface layer is fine sandy loam to silty clay loam, and the lower layers are sandy clay loam to clay.

Soybeans and cotton are the main crops.

Maintaining fertility, the content of organic matter, and tilth and controlling excess water are the main concerns in management. Returning crop residue to the soil and growing deep-rooted crops help to meet these needs on the soils that have clayey lower layers. A drainage system is needed on some of the soils, but late tillage and proper orientation of rows aid drainage of excess water on the soils that have loamy lower layers. Nitrogen and phosphorus fertilizers are needed on most of these soils, but in places a complete fertilizer and lime are needed.

CAPABILITY UNIT IIw-3

Burleson clay, 0 to 1 percent slopes, is the only soil in this unit. It is a deep, nearly level, acid soil that is moderately well drained and very slowly permeable. The surface layer and lower layers are clay.

Cotton, soybeans, and grain sorghum are the main crops.

Controlling excess water, maintaining the content of organic matter and tilth, and improving permeability are the main concerns in management. Returning crop residue to the soil and growing deep-rooted crops help to improve permeability. Late tillage and proper orientation of rows aid drainage of excess water. Nitrogen and phosphorus fertilizers are helpful. In places lime is needed for some crops.

CAPABILITY UNIT IIw-4

In this unit are deep, nearly level, alkaline soils that are well drained and moderately rapidly permeable. The surface layer is fine sandy loam to silty clay loam, and the lower layers are fine sandy loam.

Soybeans and grain sorghum are the main crops.

Maintaining fertility and the content of organic matter are the main concerns in management. Returning crop residue to the soil and growing grasses and legumes in rotation help to meet these needs. These soils respond to nitrogen and phosphorus fertilizers. Lime is not needed.

CAPABILITY UNIT IIIe-1

In this unit are deep, gently sloping, acid soils that are somewhat poorly drained to moderately well drained and are slowly permeable to very slowly permeable. The surface layer is fine sandy loam to loam, and the lower layers are clay.

Soybeans and grain sorghum are the main crops.

Controlling erosion, maintaining the content of organic matter, and improving permeability are the principal concerns in management. Returning crop residue to the soil and growing cover crops and soil-improving crops help to meet these needs. Contour farming and terraces are needed, but some areas are difficult to terrace. These soils respond to commercial fertilizers. Lime is needed in places.

CAPABILITY UNIT IIIe-2

In this unit are deep, gently sloping to sloping, acid soils that are well drained and moderately permeable. The surface layer is loam to fine sandy loam, and the lower layers are clay loam to sandy clay loam.

Grain sorghum and soybeans are the main crops.

Maintaining fertility and the content of organic matter and controlling erosion are the main concerns in management. Returning crop residue to the soil and growing cover crops and soil-improving crops help to meet these needs. Contour farming and terraces are needed. These soils respond to nitrogen and phosphorus fertilizers, and lime is needed in places.

CAPABILITY UNIT IIIe-3

Austin silty clay, 1 to 3 percent slopes, is the only soil in this unit. It is a moderately deep, gently sloping, alkaline soil that is well drained and moderately slowly permeable. The surface layer and lower layers are silty clay.

Soybeans, grain sorghum, and small grain are the main crops.

Maintaining the content of organic matter and controlling erosion are the main concerns in management. Returning crop residue to the soil and growing cover crops and soil improving crops help to meet these needs. This soil responds to nitrogen and phosphorus fertilizers. Lime is not needed.

CAPABILITY UNIT IIIe-4

Kenney loamy fine sand, 2 to 8 percent slopes, is the only soil in this unit. It is a deep, gently sloping to sloping, acid soil that is well drained and moderately rapidly permeable. The surface layer is loamy fine sand, and the lower layers are sandy clay loam.

Corn, truck crops, and small grain for grazing are the main crops.

Maintaining fertility and the content of organic matter, controlling erosion, and combating droughtiness are the main concerns in management. Returning crop residue to the soil and growing cover crops and soil-improving crops help to meet these needs. This soil responds well to complete fertilizers, applied at frequent intervals. Lime is needed in places.

CAPABILITY UNIT IIIe-5

Deport clay, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, gently sloping, acid soil that is somewhat poorly drained and very slowly permeable. The surface layer and lower layers are clay.

Cotton, soybeans, grain sorghum, and corn are the main crops.

Returning crop residue to the soil and growing deep-rooted cover crops and soil-improving crops help

to improve tilth and to control erosion. Terraces and contour farming are needed. This soil responds to nitrogen and phosphorus fertilizers. In places lime is needed for some crops.

CAPABILITY UNIT IIIw-1

Mabank fine sandy loam, 0 to 1 percent slopes, is the only soil in this unit. It is a deep, nearly level, acid soil that is somewhat poorly drained and very slowly permeable. The surface layer is fine sandy loam, and the lower layers are clay.

Cotton, soybeans, and corn are the main crops.

Maintaining fertility and the content of organic matter and providing drainage are the main concerns in management. Returning crop residue to the soil and growing deep-rooted crops help to open up this soil. Correct orientation of rows and use of a drainage system help to drain excess water. Nitrogen and phosphorus fertilizers are needed. In places lime is needed for some crops.

CAPABILITY UNIT IIIw-2

In this unit are deep, nearly level to gently sloping, acid to alkaline soils that are moderately well drained to poorly drained and are slowly permeable to very slowly permeable. The surface layer and lower layers are clay.

Cotton, soybeans, grain sorghum, and corn are the main crops.

Maintaining fertility, the content of organic matter, and tilth and controlling excess water are the main concerns in management. Returning crop residue to the soil and growing deep-rooted crops help to open up these soils. A drainage system helps to remove excess water. Nitrogen and phosphorus fertilizers are needed. In places lime is needed on the acid soils for some crops.

CAPABILITY UNIT IIIw-3

Only Redlake soils is in this unit. It consists of deep, nearly level, alkaline soils that are moderately well drained and very slowly permeable. The surface layer is very fine sandy loam, and the lower layers are clay.

Soybeans, cotton, and grain sorghum are the main crops.

Maintaining fertility and content of organic matter and increasing permeability are the main concerns in management. Returning crop residue to the soil and growing deep-rooted crops help to open up the soil. In places a drainage system is needed. Nitrogen and phosphorus fertilizers are needed.

CAPABILITY UNIT IIIs-1

Rosalie loamy fine sand, 2 to 5 percent slopes, is the only soil in this unit. It is a deep, gently sloping, acid soil that is well drained and moderately permeable. The surface layer is loamy fine sand, and the lower layers are sandy clay loam.

Corn, truck crops, and small grain for grazing are the main crops.

Maintaining fertility and the content of organic matter and combating droughtiness are the main concerns in management. Returning crop residue to the soil and growing cover crops and soil-improving crops help to meet these needs. Frequent applications of complete fertilizers are needed. In places lime is needed.

CAPABILITY UNIT IVe-1

In this unit are moderately deep to deep, gently sloping, alkaline to acid soils that are well drained to moderately well drained and very slowly permeable. The surface layer is clay loam to clay, and the lower layers are clay.

Soybeans and grain sorghum are the main crops.

Controlling erosion and improving the content of organic matter, tilth, and fertility are the main concerns in management. Returning crop residue to the soil and growing deep-rooted cover crops and soil-improving crops help to meet these needs. Terraces and contour farming help to control erosion. Nitrogen and phosphorus fertilizers are needed.

CAPABILITY UNIT IVw-1

In this unit are deep, nearly level, acid soils that are poorly drained to somewhat poorly drained and very slowly permeable. The surface layer is very fine sandy loam to silty clay, and the lower layers are clay.

Grain sorghum, soybeans, and small grain are the main crops.

Maintaining fertility and the content of organic matter and controlling excess water are the main concerns in management. Returning crop residue to the soil and using a complete drainage system and row direction are needed (fig. 14). A complete fertilizer is needed. In places lime is needed for some crops.

CAPABILITY UNIT Vw-1

In this unit are deep, nearly level, acid to alkaline soils that are well drained to somewhat poorly drained and moderately permeable. They are frequently flooded. The surface layer is fine sandy loam to clay loam, and the lower layers are sandy clay loam to clay loam.

Because of the hazard of flooding, these soils are not suited to crops. They are suited to use for pasture, woodland, recreation, and wildlife habitat.

CAPABILITY UNIT Vw-2

Kiomatia loamy fine sand, frequently flooded, is the only soil in this unit. It is a deep, nearly level to gently sloping, alkaline soil that is well drained and rapidly permeable. The surface layer is loamy fine sand, and the lower layers are fine sand.

Because of the hazard of flooding, this soil is not suited to crops. It is suited to use for pasture, woodland, recreation, and wildlife habitat.

CAPABILITY UNIT Vw-3

In this unit are deep, nearly level, acid to alkaline soils that are somewhat poorly drained to poorly drained and very slowly permeable. They are frequently flooded (fig. 15). The surface layer and lower layers are clay.

Because of the hazard of flooding, these soils are not suited to crops. They are suited to use for pasture, woodland, recreation, and wildlife habitat.

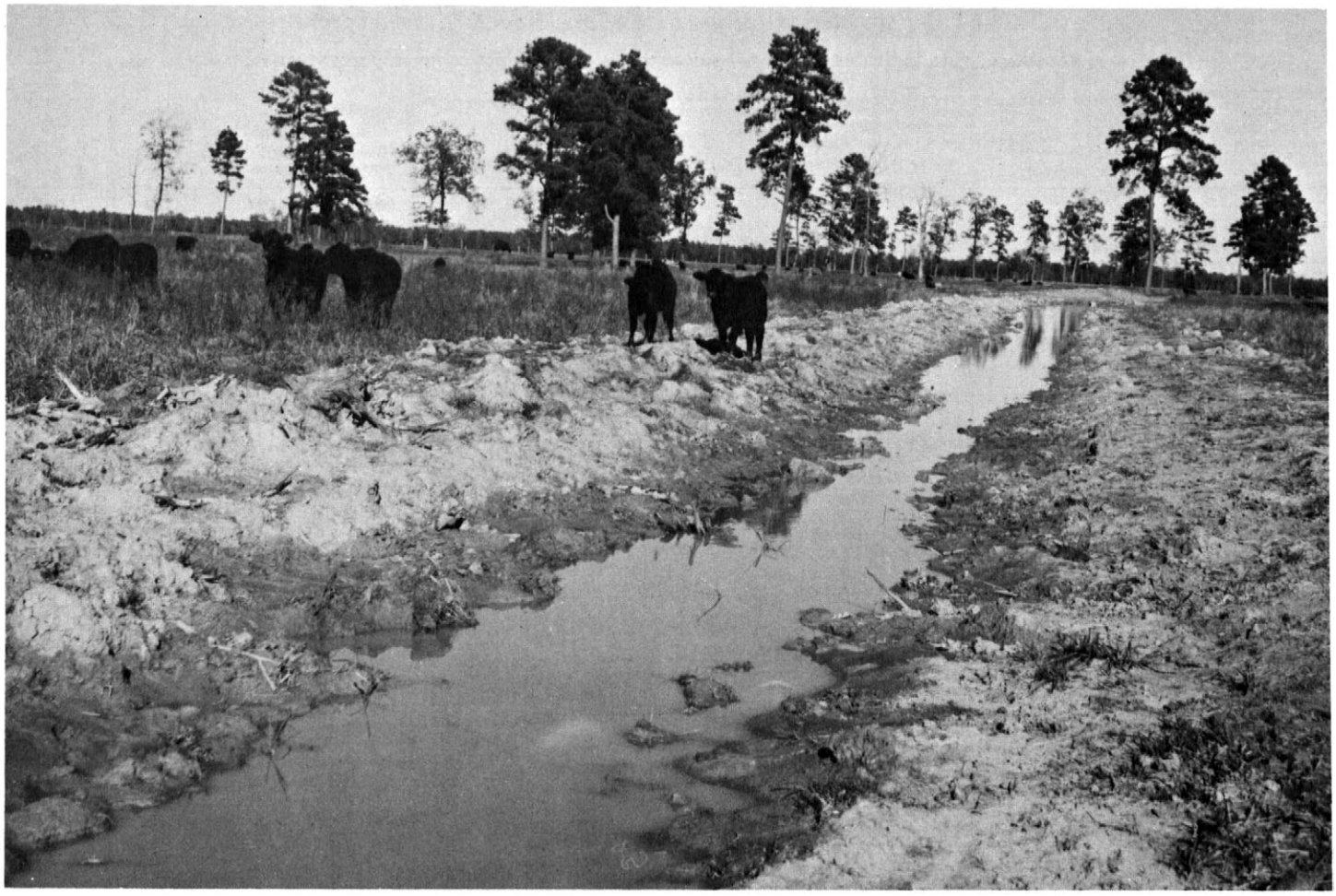


Figure 14.—**A drainage system being constructed on an area of Wrightsville-Rodessa complex.**

CAPABILITY UNIT VIe-1

In this unit are deep, sloping to strongly sloping, acid soils that are moderately well drained to well drained and very slowly permeable. The surface layer is fine sandy loam to loam, and the lower layers are clay.

These soils are not suited to crops but are moderately well suited to use for pasture, woodland, recreation, and wildlife habitat.

CAPABILITY UNIT VIe-2

In this unit are moderately deep to deep, gently sloping to sloping, alkaline soils that are well drained and moderately permeable to very slowly permeable. These soils are eroded. The surface layer and lower layers are loam to clay.

These soils are not suited to crops but are moderately well suited to use for pasture, woodland, recreation, and wildlife habitat.

CAPABILITY UNIT VIe-3

Vesey fine sandy loam, 8 to 20 percent slopes, is the only soil in this unit. It is a deep, strongly sloping to moderately steep, acid soil that is well drained and moderately permeable. The surface layer is fine sandy loam, and the lower layers are clay loam.

This soil is not suited to crops but is suited to use for pasture, woodland, recreation, and wildlife habitat.

Predicted yields

Table 2 shows predicted average yields per acre of the principal crops grown in the county. The predictions are based on estimates made by farmers, soil scientists, and others who have knowledge of yields in the county and on information taken from research data. The predicted yields are average yields per acre that can be expected by good commercial farmers at the level of management that tends to produce the highest economic returns.

The predicted yields are given only for dryland soils because widespread irrigation is not practical in the county. Not included in this table are soils that are used only for woodland, wildlife habitat, or recreation.

Crops other than those shown in table 2 are grown in the county, but the predicted yields are not included in the table, because the acreage is too small or reliable data on yields are not available.

TABLE 2.—*Predicted yields per acre of principal dryfarmed crops*

[Absence of data indicates crop is not suited to the soil or is not commonly grown on it]

Soil series and map symbols	Corn	Cotton (lint)	Grain sorghum	Oats	Soybeans	Common bermuda-grass	Coastal bermuda-grass	Bahia-grass	Fescue grass
	Bu	*Lb*	*Lb*	*Bu*	*Bu*	*AUM* [1]	*AUM*	*AUM*	*AUM*
Addielou:									
Mapped in a complex with Freestone soils.	65	300	4,000	60	45	6.5	8.5	7.5	----
Mapped in a complex with Kullit soils.	60	275	3,500	55	40	6.0	8.0	7.5	----
Annona: AfB	45	275	3,000	45	40	6.0	7.0	6.0	----
For Freestone part, see Freestone series.									
Austin: AuB	65	425	5,000	70	35	5.5	7.0	6.0	----
Bernaldo: BeB	60	375	3,600	60	40	6.5	8.0	7.0	8.0
For Elysian part, see Elysian series.									
Bryarly: BrC	----	----	2,000	40	----	5.0	6.0	5.5	----
Burleson:									
BuA	50	525	4,500	70	35	6.0	7.0	5.0	----
BuB	45	450	4,250	75	35	6.0	7.0	5.0	----
Crockett: CrB	40	300	3,000	40	35	6.5	6.5	6.0	----
Cuthand: CuD2	----	----	----	----	----	5.0	6.0	----	----
Deport: DaB	55	500	3,500	35	30	5.0	6.5	5.0	6.0
Desha:									
DeA	60	525	5,300	----	30	7.0	9.0	----	8.5
DeB	55	500	5,000	----	30	7.0	9.0	----	8.5
Ellis: EsC	----	275	1,500	35	25	4.5	5.0	4.5	----
Ellysian	65	400	4,000	55	40	7.0	8.0	6.5	----
Mapped only in complexes with Bernaldo, Muldrow, and Whakana soils.									
Ferris: FeD2	----	----	----	----	----	4.5	5.5	----	----
Freestone: FrA	65	400	3,800	65	40	8.0	9.0	7.5	7.5
For Addielou part, see Addielou series									
Gladewater:									
Gd	----	450	4,500	----	----	6.5	8.0	----	7.5
Gf	----	----	----	----	----	6.0	7.0	----	7.0
Hapludalfs: HaB	70	500	4,500	55	40	7.5	9.0	7.0	----
Houston Black: HoB	60	500	4,500	75	35	6.0	7.5	----	----
Kaufman:									
Ka	65	500	5,500	65	45	7.0	8.0	----	8.0
Kb	----	----	----	----	----	7.0	8.0	----	7.5
Kenney: KeD	25	250	2,500	25	25	5.0	7.5	----	5.5
Kiomatia: Ko	----	----	----	----	----	6.0	8.0	----	----
Kullit: KuB	50	375	3,000	60	35	6.0	9.0	7.0	9.0
For Addielou part, see Addielou series.									
Mabank: MaA	45	350	3,000	----	30	6.0	8.0	6.5	----
McKamie:									
McC	35	325	1,900	40	25	5.0	6.0	5.5	----
McE	----	----	----	----	----	4.5	5.5	5.0	----
Morse: MoD2	----	----	----	----	----	4.0	5.5	----	----

TABLE 2.—*Predicted yields per acre of principal dryfarmed crops*—Continued

Soil series and map symbols	Corn	Cotton (lint)	Grain sorghum	Oats	Soybeans	Common bermuda-grass	Coastal bermuda-grass	Bahia-grass	Fescue grass
	Bu	*Lb*	*Lb*	*Bu*	*Bu*	*AUM* [1]	*AUM*	*AUM*	*AUM*
Muldrow: Mu, Mx For Elysian part of Mx, see Elysian series.	65	475	3,500	60	35	8.5	9.0	7.0	8.0
Nahatche: Na						5.5	9.0	6.0	7.0
Oklared: Of, Ok	60	450	4,000		40	6.0	7.0		5.5
Panola: Pa	40	300	3,000		30	4.5	6.0	5.5	6.0
Redlake: Rc Rd	65 70	500 500	4,500 5,000	60 65	35 45	6.0 6.5	8.0 8.0		7.5 7.5
Rodessa Mapped only in a complex with Wrightsville soils.	45	250	3,500		30	5.5	7.0	6.5	
Roebuck variant: Rf	60	500	4,500		30	6.0	7.5		7.5
Rosalie: RsC	45	250	3,000	30	30	5.5	6.5	5.5	
Thenas: Th						5.5	9.5	7.0	7.0
Trinity: Tr Ts	60	450	5,500	65	40	7.0 6.5	8.0 7.5		8.0 7.5
Varro: Va						5.5	8.5	6.0	7.5
Vesey: VeD VeF	60	300	3,500	40	40	6.0 5.5	7.0 6.5	6.5 6.0	
Waskom: Wa	75	500	3,900	65	40	8.0	9.0	7.5	8.0
Whakana: WhD WkA For Elysian part, see Elysian series.	60 70	350 450	3,500 4,000	40 50	40 45	6.0 7.0	7.0 8.0	7.0 7.0	
Woodtell: WoC WoE	45	250	3,500	40	40	6.5 5.0	6.5 5.5	5.5 5.0	
Wrightsville: Wr For Rodessa part, see Rodessa series.	40	300	2,500		25	5.0	6.0	5.5	5.5

[1] Animal-unit-month is a term used to express the carrying capacity of pasture. It is the number of animal units carried per acre, multiplied by the number of months the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 2 months of grazing for two cows has a carrying capacity of 4 animal-unit-months.

The predicted yields given in table 2 can be expected if the following management practices are used:

1. Rainfall is effectively used and conserved.
2. Surface or subsurface drainage systems, or both, are installed.
3. Crop residue is returned to the soil to maintain soil tilth.
4. Minimum but timely tillage is used.
5. Measures to control insects, disease, and weeds are consistently used.
6. Fertilizer is applied according to soil test and crop needs.
7. Suitable crop varieties are used at recommended seeding rates.

Pasture and Hayland [3]

The livestock industry is important to the economy of Red River County. About 43 percent of the acreage in the county is used for pastureland and hayland.

Pastureland consists mainly of warm-season grasses and cool-season legumes, but some acreage is used for

[3] ALFRED L. PACE, agronomist, Soil Conservation Service, helped to prepare this section.

Figure 15.—An area of Gladewater clay, frequently flooded.

cool-season perennial grasses. Both common bermudagrass and Coastal bermudagrass are used on the deep, well-drained soils. Pensacola bahiagrass is used both on deep, well-drained soils and on the slightly wet to wet soils. Introduced bluestem grass, mainly King Ranch bluestem, is used on a small acreage. The most commonly used legumes are vetch, crimson clover, and burclover. These are overseeded on established stands of bermudagrass and bahiagrass.

The major management practices needed on pastureland are fertilizing, weed control, and controlled grazing. Fertilizers should be applied according to plant needs as determined by soil tests and desired production. Weed control can be accomplished by either mechanical means, mowing or shredding, or by the use of weed control herbicides. Weed control is not so much a concern on well-managed pastureland as on overused, poorly managed pastureland. A good stand of well-managed grass tends to crowd out weeds. Pasture plants should not be grazed below the height that has been proven best for that particular kind of pasture plant.

Good cover should be left during winter to prevent erosion and to protect the roots from cold. This cover prevents winter killing and helps to insure rapid growth in spring. Compaction of the soil by trampling is reduced if pastures are not overgrazed.

The amount of beef that can be produced on a farm is directly related to the amount of forage produced. The forage produced by a pasture can be effectively increased by fertilization, planting winter legumes, controlling weeds, and controlling grazing. Temporary pasture is often used to supplement the permanent pasture. Sudangrass, johnsongrass, and sorghum-sudangrasses make good supplemental summer pasture. Small grain provides good supplemental winter forage.

Well-managed pastureland has one main grass, is amply supplied with water, and is free of weeds. It is stocked according to the amount of forage available and is grazed only to a height that permits plants to remain vigorous.

Management of hayland is as important as the management of cropland or pastureland. Hay crops in Red River County consist mainly of native bluestem, bermudagrass, or bahiagrass. Yields of hay range from ½ ton to 8 tons or more per acre, depending on the kind of soil, the grass used, the kind and amount of fertilizer used, and the level of management.

Hay should be cut at a height that has been proven best for the grass used. Sod-forming grasses such as bermudagrass and bahiagrass generally can be mowed lower than bunchgrasses such as bluestems. Mowing too low or too often damages hayland just as overgrazing damages pastureland. Mowing at the proper height

helps to maintain plant vigor and leaves residue that can be returned to the soil to help maintain the content of organic matter. Mowing when the soil is wet tends to pack the surface layer, causing excessive runoff and poor plant growth. Weeds can be controlled by mowing, shredding, or using herbicides.

If native haylands are seriously damaged by drought, fire, or poor management, they should not be cut but should be allowed to make a full season's growth for 1 year or more. This permits the grasses to reestablish a strong root system and regain their vigor. Weakened grasses are easily killed in winter and invaded by weeds.

Well-established native grasses generally can be kept vigorous by good management without the use of fertilizers. Commercial fertilizers improve the production of bermudagrass, bahiagrass, and johnsongrass.

Haylands on deep, fertile soils are very productive. Management is easier if the surface is relatively smooth. Soils that are low in content of organic matter or that are in poor tilth should be conditioned for 1 year or more with legumes before establishing plants for hay production.

Pasture and hayland groups

The soils of Red River County are placed in 16 pasture and hayland groups according to their suitability for forage production. The soils in each group are enough alike to be suited to the same grasses, to have similar limitations and hazards, to require similar management, and to have similar productivity and other responses to management. Thus, the pasture and hayland group is a convenient grouping of soils from which many statements about their management can be made. The pasture and hayland groups are identified by numerals and uppercase letters; for example, 1A. The numbers are part of a statewide system. They are not consecutive, because not all groups in the system are represented by the soils of Red River County.

The names of the soils in any group can be found by referring to the "Guide to Mapping Units" at the back of this survey.

PASTURE AND HAYLAND GROUP 1A

In this group are loamy to clayey, nearly level to gently sloping soils on bottom lands. Some of the soils are subject to overflow. These soils crack and absorb water rapidly when dry, but they swell and absorb water very slowly when wet. They are moderately well drained to somewhat poorly drained, slowly permeable or very slowly permeable, and acid to alkaline. Plant-soil-moisture relationships are poor.

Preparing a seedbed on these soils is difficult. Grazing when the soils are wet causes poor tilth in the surface layer. Drainage is sometimes needed for good growth of forage. Nitrogen and phosphorus fertilizers are needed for sustained forage production. Lime is generally not needed.

Suitable grasses and legumes are tall fescue, dallisgrass, johnsongrass, white clover, burclover, black medic, vetch, and singletary peas.

PASTURE AND HAYLAND GROUP 1B

In this group are clayey, nearly level soils on bottom lands. Some of the soils are subject to overflow. These soils crack and absorb water rapidly when dry, but they swell and absorb water very slowly when wet. They are poorly drained, very slowly permeable, and acid. Plant-soil-moisture relationships are poor.

Preparing a seedbed on these soils is difficult. The soils are wet for long periods, and grazing during this time causes severe puddling. Drainage is needed for good growth of forage. Nitrogen and phosphorus fertilizers are needed for sustained forage production. In places lime is needed on the more acid soils.

Suitable grasses and legumes are tall fescue, dallisgrass, johnsongrass, bermudagrass, white clover, burclover, vetch, and singletary peas.

PASTURE AND HAYLAND GROUP 2A

In this group are loamy, nearly level soils on bottom lands. Some of the soils are subject to overflow. These soils are moderately well drained to well drained, very slowly permeable to moderately rapidly permeable, and acid to alkaline. Plant-soil-moisture relationships are fair to good.

Preparing a seedbed on these soils is not difficult. Nitrogen and phosphorus fertilizers are needed for sustained forage production.

Suitable grasses and legumes are bermudagrass, fescue, singletary peas, and white clover.

PASTURE AND HAYLAND GROUP 2C

Only Nahatche soils, frequently flooded, is in this group. It consists of nearly level soils on bottom lands. They are subject to overflow. These soils are somewhat poorly drained, moderately permeable, and acid. A high water table is near the surface for several months of the year. Plant-soil-moisture relationships are fair.

Preparing a seedbed on this soil is a concern because of the hazard of flooding. Drainage is sometimes needed for good growth of forage. Nitrogen and phosphorus fertilizers are needed for sustained forage production. Lime should not be applied until the lime requirement for the particular pasture is checked.

Suitable grasses and legumes are bermudagrass, bahiagrass, white clover, burclover, and vetch.

PASTURE AND HAYLAND GROUP 3A

Kiomatia loamy fine sand, frequently flooded, is the only soil in this group. It is a sandy, gently sloping soil on bottom lands. It is subject to overflow. This soil absorbs water rapidly when dry or moist. It is well drained, rapidly permeable, and alkaline. Plant-soil-moisture relationships are poor.

Preparing a seedbed on this soil is difficult. Nitrogen and phosphorus fertilizers are needed for sustained forage production.

Suitable grasses and legumes are bermudagrass and crimson clover.

PASTURE AND HAYLAND GROUP 7A

In this group are gently sloping, clayey soils on uplands. They crack and absorb water rapidly when dry but swell and absorb water very slowly when wet.

These soils are well drained to somewhat poorly drained, very slowly permeable, and acid to alkaline. Plant-soil-moisture relationships are poor.

Preparing a seedbed on these soils is difficult. Nitrogen and phosphorus fertilizers are needed for sustained forage production, but lime is seldom needed. Grazing when the soils are wet causes poor tilth in the surface layer.

Suitable grasses and legumes are bermudagrass, King Ranch bluestem, burclover, black medic, vetch, and singletary peas.

PASTURE AND HAYLAND GROUP 7B

In this group are clayey, gently sloping to sloping, eroded soils on uplands and terraces. They crack and absorb water rapidly when dry but swell and absorb water very slowly when wet. These soils are well drained, very slowly permeable, and alkaline. Plant-soil-moisture relationships are poor.

Preparing a seedbed on these soils is difficult and hazardous. Nitrogen and phosphorus fertilizers are needed for sustained forage production. Grazing when the soils are wet causes poor tilth in the surface layer.

Suitable grasses and legumes are bermudagrass, johnsongrass, King Ranch bluestem, burclover, black medic, vetch, and singletary peas.

PASTURE AND HAYLAND GROUP 7C

Austin silty clay, 1 to 3 percent slopes, is the only soil in this group. It is a clayey, gently sloping soil on uplands. It is well drained, moderately slowly permeable, and alkaline. Plant-soil-moisture relationships are fair.

Preparing a seedbed on this soil is moderately difficult. Nitrogen and phosphorus fertilizers are needed for sustained forage production.

Suitable grasses and legumes are bermudagrass, black medic, vetch, and singletary peas.

PASTURE AND HAYLAND GROUP 7D

Cuthand loam, 4 to 8 percent slopes, eroded, is the only soil in this group. It is a gently sloping to sloping soil on uplands. It is eroded. This soil is well drained, moderately permeable, and alkaline. Plant-soil-moisture relationships are fair, and the soil is somewhat droughty.

Preparing a seedbed on this soil is difficult because of gullies. Nitrogen and phosphorus fertilizers are needed for sustained forage production.

Suitable grasses and legumes are bermudagrass, black medic, and vetch.

PASTURE AND HAYLAND GROUP 8A

In this group are loamy, nearly level to gently sloping soils on uplands and terraces. These soils are well drained to somewhat poorly drained, very slowly permeable, and acid. Plant-soil-moisture relationships are poor.

Preparing a seedbed on these soils is easy. Nitrogen, phosphorus, and potassium fertilizers are needed for sustained forage production. In places lime is needed for some legumes.

Suitable grasses and legumes are bermudagrass, bahiagrass, crimson clover, and vetch.

PASTURE AND HAYLAND GROUP 8B

In this group are loamy, sloping to strongly sloping soils on uplands and terraces. The soils are well drained to moderately well drained, very slowly permeable, and acid. Plant-soil-moisture relationships are poor.

Preparing a seedbed on these soils is difficult. The soils should be without cover only for short periods of time. Grazing or cutting the plants too close to the ground causes erosion. Nitrogen, phosphorus, and potassium fertilizers are needed for sustained forage production.

Suitable grasses and legumes are bermudagrass, bahiagrass, crimson clover, vetch, and singletary peas.

PASTURE AND HAYLAND GROUP 8C

In this group are loamy, nearly level to sloping soils on uplands and terraces. These soils are somewhat poorly drained to well drained, very slowly permeable to moderately permeable, and acid. Plant-soil-moisture relationships are good.

Preparing a seedbed on these soils is easy. Nitrogen, phosphorus, and potassium fertilizers are needed. In places lime is needed for some legumes.

Suitable grasses and legumes are bermudagrass, bahiagrass, lovegrass, crimson clover, and vetch.

PASTURE AND HAYLAND GROUP 8D

Vesey fine sandy loam, 8 to 20 percent slopes, is the only soil in this group. It is a loamy, strongly sloping to moderately steep soil on terraces. This soil is well drained, moderately permeable, and acid. Plant-soil-moisture relationships are good.

Preparing a seedbed on this soil is moderately difficult. Nitrogen, phosphorus, and potassium fertilizers are generally needed for sustained forage production. The soil should not be left without cover for long periods, and grazing must be limited to maintain good cover.

Suitable grasses and legumes are bermudagrass, bahiagrass, lovegrass, vetch, and crimson clover.

PASTURE AND HAYLAND GROUP 8E

In this group are loamy to clayey, nearly level soils on uplands and terraces. These soils are poorly drained to somewhat poorly drained, very strongly permeable, and acid. Plant-soil-moisture relationships are poor.

Preparing a seedbed on these soils is difficult. Nitrogen, phosphorus, and potassium fertilizers and lime are needed for sustained forage production. Drainage is also needed.

Suitable grasses and legumes are bahiagrass, tall fescue, bermudagrass, and singletary peas.

PASTURE AND HAYLAND GROUP 9A

Rosalie loamy fine sand, 2 to 5 percent slopes, is the only soil in this group. It is a sandy, gently sloping soil on uplands. This soil is well drained, moderately permeable, and acid. Plant-soil-moisture relationships are fair.

Preparing a seedbed on this soil is easy, but in places soil blowing is a hazard if the surface is not protected. Nitrogen, phosphorus, and potassium fertilizers and lime are needed for sustained forage pro-

duction. Fertilizers should be applied at frequent intervals.

Suitable grasses and legumes are lovegrass, bermudagrass, vetch, and crimson clover.

PASTURE AND HAYLAND GROUP 9B

Kenney loamy fine sand, 2 to 8 percent slopes, is the only soil in this group. It is a sandy, gently sloping to sloping soil on uplands and terraces. This soil is well drained, moderately rapidly permeable, and acid. Plant-soil-moisture relationships are poor, and the soil is droughty.

Preparing a seedbed on this soil is easy, but in places soil blowing is a hazard if the surface is not protected. Nitrogen, phosphorus, and potassium fertilizers and lime are needed for sustained forage production. Fertilizers should be applied at frequent intervals.

Suitable grasses and legumes are coastal bermudagrass, crimson clover, and vetch.

Woodland [4]

Originally, Red River County was mainly woodland, but now it is about 46 percent woodland. Pine trees commonly are on uplands, and hardwoods generally predominate on bottom lands along rivers and creeks. Good stands of commercial trees are produced in the county, although stocking and growth rates are well below the potential of most soils.

The main value of most of the woodland is as a source of raw wood products. It also has value for grazing, wildlife habitat, recreation, esthetic purposes, and the conservation of soil and water.

Table 3 lists the potential productivity and the management concerns of the soils in Red River County. Soils not suited to commercial stands of trees are not included. Some of the terms used in the table are explained in the following paragraphs.

Each woodland suitability group is made up of soils that are suited to the same kinds of trees, that need about the same kind of management to produce these trees, and that have about the same potential productivity. It is identified by a three-part symbol. The first element of the group is a number, from 1 through 5, that expresses potential productivity of an indicator species based on site index. Site index is the average height of the dominant trees in the stand, in feet, at a reference age (at age 30 for cottonwood and at age 50 for other species).

The second element in the symbol is a lowercase letter that indicates soil properties that cause moderate to severe restrictions or limitations in woodland use or management. An explanation of the second element follows:

w. Soils in which excessive water, either seasonally or year long, causes significant limitations for woodland use or management. These soils have restricted drainage, a high water table, or are subject to overflow, which adversely affects either stand development or management.

s. Sandy soils that have moderate to severe restrictions or limitations for woodland use or management. These soils impose equipment limitations, have low available water capacity, and are generally low in available plant nutrients.

c. Soils that have restrictions or limitations for woodland use or management because of the kind or amount of clay in the upper part of the profile.

o. Soils that have no significant restrictions or limitations for woodland use or management.

The third element in the symbol indicates the degree of hazards or limitations and the general suitability of the soils for certain kinds of trees. The four soil-related items considered are (1) hazard of erosion, (2) equipment restrictions, (3) plant competition, and (4) seedling mortality.

The *numeral 1* indicates soils that have few if any limitations to management and are suited to needleleaf trees

The *numeral 2* indicates soils that have one or more moderate limitations to management and are suited to needleleaf trees.

The *numeral 3* indicates soils that have one or more severe limitations to management and are suited to needleleaf trees.

The *numeral 4* indicates soils that have few if any limitations to management and are suited to broadleaf trees.

The *numeral 5* indicates soils that have one or more moderate limitations to management and are suited to broadleaf trees.

The *numeral 6* indicates soils that have one or more severe limitations to management and are suited to broadleaf trees.

The *numeral 7* indicates soils that have few if any limitations to management and are suited to either needleleaf or broadleaf trees.

The *numeral 8* indicates soils that have one or more moderate limitations to management and are suited to either needleleaf or broadleaf trees.

The *numeral 9* indicates soils that have one or more severe limitations to management and are suited to either needleleaf or broadleaf trees.

The *numeral 0* indicates soils that are not suited to the production of major commercial wood products.

Important tree species are commercially important trees that are suited to the soil. These are the trees that woodland managers will generally favor in intermediate or improvement cuttings. Potential productivity of these trees is expressed in terms of site index.

Important understory vegetation consists of understory grasses, forbs, or low shrubs for a medium tree canopy class (36 to 55 percent canopy). Productivity is expressed in pounds of air-dry forage per acre. Where yield data are not available and estimates cannot be made, species are listed in order of productivity.

Management concerns are those factors that should be considered by the woodland landowner in making

[4] By NORMAN O. WILSON, woodland conservationist, Soil Conservation Service.

TABLE 3.—*Suitability of*

[Soils not listed are

Soil series and map symbols	Woodland suitability group	Potential productivity			Yield
		Important tree species	Site index	Important understory vegetation (medium canopy)	
					Pounds per acre
Addielou Mapped only in complexes with Freestone and Kullit soils.	3o7	Loblolly pine	80	Little bluestem	750
		Shortleaf pine	70	Beaked panicums	500
		Southern red oak	70	Longleaf uniola	500
		Sweetgum	70	Purpletop	250
				Low panicums	250
				Other	250
				Total, favorable years	2,500
Annona: AfB For Freestone part, see Freestone series.	4c2	Loblolly pine	74	Little bluestem	500
		Shortleaf pine	65	Browseed paspalum	200
				Indiangrass	200
				Longleaf uniola	200
				Low panicums	200
				Purpletop	100
				Sedges	200
				Other	400
				Total, favorable years	2,000
Bernaldo: BeB For Elysian part, see Elysian series.	2o7	Loblolly pine	90	Pinehill bluestem	450
		Shortleaf pine	80	Beaked panicums	450
		Sweetgum	80	Indiangrass	250
		Southern red oak	80	Longleaf uniola	700
				Purpletop	200
				Other	200
				Total, favorable years	2,250
Bryarly: BrC	5c2	Loblolly pine	60	Little bluestem	500
		Shortleaf pine	50	Indiangrass	100
				Longleaf uniola	200
				Purpletop	150
				Low panicums	150
				Perennial forbs	150
				Other	250
				Total, favorable years	1,500
Desha: DeA, DeB	2w6	Cottonwood	100	Sedges	700
		Green ash	80	Virginia wildrye	500
		Cherrybark oak	90	Beaked panicums	300
		Water oak	90	Longleaf uniola	300
		Sweetgum	90	Switchcane	200
		Willow oak	90	Other	500
				Total, favorable years	2,500
Elysian Mapped only in complexes with Bernaldo, Muldrow, and Whakana soils.	2o7	Loblolly pine	90	Pinehill bluestem	500
		Shortleaf pine	80	Beaked panicums	500
		Sweetgum	(1)	Longleaf uniola	750
		Southern red oak	(1)	Purpletop	300
				Florida paspalum	200
				Perennial forbs	100
				Other	250
				Total, favorable years	2,600
Freestone: FrA For Addielou part, see Addielou series.	3w8	Loblolly pine	80	Little bluestem	400
		Shortleaf pine	70	Beaked panicums	400
		Sweetgum	80	Longleaf uniola	400
				Purpletop	200
				Sedges	500
				Perennial forbs	400
				Other	200
				Total, favorable years	2,500

the soils for woodland

not suited to woodland]

Management concerns				Trees to plant
Erosion hazard	Equipment limitations	Plant competition	Seedling mortality	
Slight	Slight	Slight	Slight	Loblolly pine, slash pine.
Slight	Moderate	Moderate	Moderate	Loblolly pine, shortleaf pine.
Slight	Slight	Moderate	Slight	Loblolly pine, slash pine.
Slight	Moderate	Slight	Slight	Loblolly pine, slash pine.
Slight	Severe	Severe	Moderate	Cottonwood, green ash, cherrybark oak, water oak, sycamore, willow oak.
Slight	Slight	Moderate	Slight	Loblolly pine, sweetgum, cherrybark oak.
Slight	Moderate	Moderate	Slight	Loblolly pine, shortleaf pine, sweetgum, slash pine.

TABLE 3.—*Suitability of the*

Soil series and map symbols	Woodland suitability group	Potential productivity			
		Important tree species	Site index	Important understory vegetation (medium canopy)	Yield
					Pounds per acre
Gladewater: Gd, Gf	2w6	Water oak	90	Beaked panicums	500
		Willow oak	90	Rustyseed paspalum	250
		Green ash	(1)	Virginia wildrye	250
		Elm	(1)	Switchcane	500
		Sweetgum	90	Low panicums	250
				Sedges	400
				Other	200
				Total, favorable years	2,350
Hapludalfs: HaB	2o4	Cottonwood	100	Sedges	500
		Southern red oak	80	Beaked panicums	500
		Water oak	80	Switchcane	400
		Sweetgum	(1)	Virginia wildrye	200
				Longleaf uniola	200
				Perennial forbs	200
				Other	300
				Total, favorable years	2,300
Kaufman: Ka, Kb	1w6	Cottonwood	110	Virginia wildrye	400
		Sweetgum	100	Beaked panicums	300
		Water oak	100	Rustyseed paspalum	500
				Switchcane	300
				Sedges	850
				Longleaf uniola	200
				Other	200
				Total, favorable years	2,750
Kenney: KeD	3s2	Loblolly pine	80	Pinehill bluestem	700
		Shortleaf pine	70	Purpletop	500
				Longleaf uniola	300
				Brownseed paspalums	300
				Sedges	200
				Perennial forbs	600
				Other	300
				Total, favorable years	2,900
Kiomatia: Ko	2w5	Cottonwood	100	Sedges	600
		Sweetgum	95	Beaked panicums	600
				Switchcane	600
				Virginia wildrye	200
				Longleaf uniola	200
				Perennial forbs	400
				Other	200
				Total, favorable years	2,800
Kullit: KuB For Addielou part, see Addielou series.	2w8	Loblolly pine	90	Switchcane	300
		Shortleaf pine	75	Sedges	300
		Sweetgum	80	Longleaf uniola	250
				Purpletop	250
				Low paspalums	300
				Perennial forbs	400
				Other	200
				Total, favorable years	2,000
McKamie: McC, McE	3c2	Loblolly pine	80	Pinehill bluestem	750
				Longleaf uniola	200
				Three-awns	200
				Low panicums	200
				Purpletop	200
				Perennial forbs	200
				Other	200
				Total, favorable years	1,950

soils for woodland—Continued

Management concerns				Trees to plant
Erosion hazard	Equipment limitations	Plant competition	Seedling mortality	
Slight	Severe	Severe	Moderate	Water oak, sweetgum.
Slight	Slight	Slight	Slight	Cottonwood, red oak, water oak, black walnut.
Slight	Severe	Severe	Moderate	Cottonwood.
Slight	Moderate	Moderate	Moderate	Loblolly pine, slash pine.
Slight	Moderate	Moderate	Moderate	Cottonwood, sweetgum, black walnut, sycamore.
Slight	Moderate	Moderate	Slight	Loblolly pine, sweetgum.
Slight	Moderate	Moderate	Moderate	Loblolly pine.

TABLE 3.—*Suitability of the*

Soil series and map symbols	Woodland suitability group	Potential productivity			
		Important tree species	Site index	Important understory vegetation (medium canopy)	Yield
					Pounds per acre
Muldrow: Mu, Mx For Elysian part of Mx, see Elysian series.	2w5	Sweetgum	90	Virginia wildrye	200
		Green ash	90	Canada wildrye	200
		Hackberry	(1)	Sedges	400
		Pecan	(1)	Switchcane	300
		Willow oak	(1)	Beaked panicums	300
		Water oak	(1)	Longleaf uniola	250
				Perennial forbs	250
				Other	250
				Total, favorable years	2,150
Nahatche: Na	1w6	Water oak	100	Switchcane	300
		Willow oak	100	Beaked panicums	300
		Cottonwood	100	Longleaf uniola	200
				Virginia wildrye	200
				Sedges	400
				Greenbriar	300
				Other	300
				Total, favorable years	2,000
Oklared: Of, Ok	2o4	Cottonwood	100	Sedges	400
		Southern red oak	80	Beaked panicums	300
		Water oak	90	Switchcane	300
				Virginia wildrye	200
				Longleaf uniola	300
				Greenbriar	300
				Other	400
				Total, favorable years	2,200
Redlake: Rc, Rd	3w6	Cottonwood	90	Virginia wildrye	200
		Southern red oak	70	Canada wildrye	200
		Sweetgum	80	Sedges	500
				Beaked panicums	300
				Switchcane	300
				Longleaf uniola	200
				Greenbriar	300
				Other	400
				Total, favorable years	2,400
Rodessa Mapped only in a complex with Wrightsville soils.	3w8	Loblolly pine	80	Little bluestem	600
		Shortleaf pine	70	Beaked panicums	600
		Water oak	(1)	Longleaf uniola	300
		Willow oak	(1)	Purpletop	300
		Post oak	(1)	Other	200
		Southern red oak	(1)	Total, favorable years	2,000
Roebuck variant: Rf	2w6	Water oak	90	Virginia wildrye	200
		Pecan	(1)	Sedges	500
		Sycamore	(1)	Beaked panicums	500
		Sweetgum	(1)	Longleaf uniola	300
				Switchcane	200
				Greenbriar	300
				Other	200
				Total, favorable years	2,200
Rosalie: RsC	3s2	Loblolly pine	80	Longleaf uniola	350
		Shortleaf pine	70	Purpletop	150
				Pinehill bluestem	560
				Low panicums	125
				Low paspalums	125
				Indiangrass	150
				Other	250
				Total, favorable years	1,710

soils for woodland—Continued

Management concerns				Trees to plant
Erosion hazard	Equipment limitations	Plant competition	Seedling mortality	
Slight	Moderate	Moderate	Moderate	Cottonwood, sweetgum, green ash, sycamore.
Slight	Severe	Severe	Moderate	Cottonwood, water oak.
Slight	Slight	Slight	Slight	Cottonwood, southern red oak, water oak.
Slight	Severe	Moderate	Moderate	Water oak, cottonwood, sweetgum, green ash.
Slight	Moderate	Moderate	Slight	Loblolly pine, shortleaf pine, southern red oak.
Slight	Moderate	Severe	Severe	Water oak, green ash, sweetgum.
Slight	Moderate	Moderate	Moderate	Loblolly pine, shortleaf pine.

TABLE 3.—*Suitability of the*

Soil series and map symbols	Woodland suitability group	Potential productivity			
		Important tree species	Site index	Important understory vegetation (medium canopy)	Yield
					Pounds per acre
Thenas: Th	1w8	Loblolly pine	100	Virginia wildrye	200
		Sweetgum	100	Plumegrass	100
		Blackgum	90	Beaked panicums	400
		Southern red oak	(1)	Switchcane	300
		White oak	(1)	Longleaf uniola	300
				Sedges	500
				Other	200
				Total, favorable years	2,000
Trinity: Tr, Ts	1w6	Sweetgum	100	Virginia wildrye	400
		Cottonwood	(1)	Beaked panicums	400
		Water oak	(1)	Purpletop	300
		Willow oak	(1)	Longleaf uniola	500
		Green ash	(1)	Switchcane	400
				Sedges	500
				Other	500
				Total, favorable years	3,000
Varro: Va	1w5	Cottonwood	110	Sedges	625
		Water oak	100	Beaked panicums	625
		Willow oak	(1)	Switchcane	250
				Virginia wildrye	375
				Low panicums	250
				Other	375
				Total, favorable years	2,500
Vesey: VeD, VeF	3o1	Loblolly pine	80	Pinehill bluestem	500
		Shortleaf pine	70	Longleaf uniola	500
				Beaked panicums	500
				Low panicums	150
				Low paspalums	100
				Indiangrass	250
				Other	500
				Total, favorable years	2,500
Waskom: Wa	2w5	Cottonwood	100	Florida paspalum	500
		Pecan	(1)	Virginia wildrye	375
				Switchcane	250
				Beaked panicums	375
				Sedges	750
				Other	250
				Total, favorable years	2,500
Whakana: WhD, WkA For Elysian part of WkA, see Elysian series.	2o7	Loblolly pine	90	Pinehill bluestem	400
		Shortleaf pine	80	Beaked panicums	400
		Sweetgum	90	Longleaf uniola	400
		Southern red oak	80	Purpletop	100
				Low panicums	200
				Other	500
				Total, favorable years	2,000
Woodtell: WoC, WoE	4c2	Loblolly pine	70	Pinehill bluestem	400
		Shortleaf pine	60	Indiangrass	100
				Longleaf uniola	250
				Purpletop	50
				Low panicums	150
				Perennial forbs	200
				Other	100
				Total, favorable years	1,250
Wrightsville: Wr For Rodessa part, see Rodessa series.	3w9	Loblolly pine	80	Switchcane	300
		Sweetgum	80	Beaked panicums	300
		Water oak	80	Giant paspalum	100
				Low panicums	300
				Perennial forbs	400
				Other	300
				Total, favorable years	1,700

[1] Site index not determined.

soils for woodland—Continued

Management concerns				Trees to plant
Erosion hazard	Equipment limitations	Plant competition	Seedling mortality	
Slight	Moderate	Moderate	Moderate	Loblolly pine, slash pine, sycamore, southern red oak, sweetgum, pecan, black walnut, cottonwood.
Slight	Severe	Severe	Moderate	Cottonwood, green ash, water oak.
Slight	Moderate	Moderate	Moderate	Cottonwood, water oak.
Slight	Slight	Slight	Slight	Loblolly pine, shortleaf pine, slash pine.
Slight	Moderate	Moderate	Moderate	Cottonwood, pecan.
Slight	Slight	Slight	Slight	Loblolly pine, slash pine, sweetgum, southern red oak.
Slight	Moderate	Slight	Moderate	Slash pine, loblolly pine.
Slight	Severe	Slight	Moderate to severe	Loblolly pine, sweetgum, southern red oak.

decisions during the establishment and development of his woodlands.

The hazard of erosion is *slight* if erosion control is unimportant. A rating of *moderate* indicates the need for some attention to prevent unnecessary soil erosion. A rating of *severe* indicates that intensive treatment or special equipment or techniques of operation are needed to prevent excessive soil losses.

Equipment limitations reflect limitations in the use of equipment for managing or harvesting the tree crop. A *slight* rating indicates that use of equipment is seldom limited in kind or time of year. A *moderate* rating indicates a need for modified equipment or seasonal restriction because of slope, soil texture, wetness, or flooding. A rating of *severe* indicates the need for specialized equipment because of one or more of the above factors.

Plant competition reflects the rate of invasion by unwanted trees and shrubs on different kinds of soil when openings are made in the canopy. A rating of *slight* indicates that the understory plants will not prevent the establishment or normal development of a new stand of desirable trees. A *moderate* rating indicates that establishment or development of a new stand of desirable trees is likely to be delayed by plant competition. A rating of *severe* indicates that adequate establishment and development is likely to be prevented if intensive site preparation or special management practices are not used.

Seedling mortality refers to the expected degree of mortality of seedlings, either natural or planted, as influenced by the kinds of soil. A rating of *slight* indicates that less than 25 percent mortality is expected during the first year after establishment. A rating of *moderate* indicates that 25 to 50 percent mortality is expected under normal conditions. A rating of *severe* indicates that more than 50 percent mortality is expected if intensive site preparation and management are not used.

Woodland suitability groups

Management of woodland can be planned more effectively if soils are grouped according to those characteristics that affect the growth of trees and the management of stands. For this reason, the soils of Red River County that support trees are placed into 17 woodland suitability groups. Each group consists of soils that have about the same suitability for wood crops, have about the same restrictions and limitations, require about the same management, and have about the same potential productivity.

In this subsection the woodland suitability groups are described and some management concerns are discussed.

WOODLAND SUITABILITY GROUP 1w5

Varro clay loam is the only soil in this group. It is a well drained, frequently flooded soil on bottom lands. Permeability is moderate, and available water capacity is high. Slopes are nearly level.

Hardwood trees and a few pine trees grow on this soil. The supply of moisture is sufficient to cause moderate plant competition from unwanted trees, shrubs, and vines. When openings are made in the canopy, weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 1w6

In this group are clayey to loamy, somewhat poorly drained soils on bottom lands. Most of the soils are subject to overflow. Permeability is moderate to very slow, and available water capacity is medium to high. Slopes are nearly level.

Hardwoods and a few pines are the principal trees that grow on these soils. The supply of moisture is sufficient to cause severe plant competition from unwanted trees, shrubs, and vines. When openings are made in the canopy, weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 1w8

Thenas fine sandy loam, frequently flooded, is the only soil in this group. It is a moderately well drained soil on bottom lands. Permeability is moderate, and available water capacity is high. Slopes are nearly level.

Pine and hardwood trees grow on this soil. The supply of moisture is sufficient to cause severe plant competition from unwanted trees, shrubs, and vines. When openings are made in the canopy, weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 2o4

In this group are loamy, well-drained soils on bottom lands and terraces. Some of the soils are subject to overflow. Permeability is moderate to moderately rapid, and available water capacity is medium. Slopes are nearly level to gently sloping.

Hardwoods and a few pines are the principal trees that grow on these soils. The supply of moisture is adequate for stands to become established. Plant competition is slight, and open areas become covered with vines and shrubs.

WOODLAND SUITABILITY GROUP 2o7

In this group are loamy, well-drained soils on uplands and terraces. Permeability is moderate, and available water capacity is medium to high. Slopes are nearly level to sloping.

Pines and hardwoods are the principal trees that grow on these soils. The supply of moisture is sufficient to cause slight to moderate plant competition. Open areas become covered with vines and shrubs. Weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 2w5

In this group are loamy to sandy, somewhat poorly drained to well-drained soils on terraces and flood plains. Permeability is rapid to very slow, and available water capacity is low to high. Slopes are nearly level to gently sloping.

Hardwoods and pine trees grow on these soils. The supply of moisture is sufficient to cause moderate plant competition. Open areas become covered with vines and shrubs. Weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 2w6

In this group are clayey, poorly drained to somewhat poorly drained soils on bottom lands. Some of the soils are subject to overflow. Permeability is slow to very slow, and available water capacity is high. Slopes are nearly level to gently sloping.

Hardwoods and a few pines are the principal trees that grow on these soils. The supply of moisture is sufficient to cause severe plant competition. When openings are made in the canopy, weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 2w8

The Kullit part of the Kullit-Addielou complex, 1 to 3 percent slopes, is the only soil in this group. It is a loamy, moderately well drained soil on uplands and high terraces. Permeability is moderate, and available water capacity is medium. Slopes are gently sloping.

Pines and a few hardwoods are the principal trees that grow on these soils (fig. 16). The supply of moisture is such that plant competition is moderate. Open areas quickly become covered with unwanted vines and shrubs. Weeding is necessary to release young seedlings for normal growth.

WOODLAND SUITABILITY GROUP 3o1

In this group are loamy, well-drained soils on uplands. Permeability is moderate, and available water capacity is medium. Slopes are gently sloping to moderately steep.

Pines are the principal trees that grow on these soils. The supply of moisture is sufficient to cause slight plant competition.

WOODLAND SUITABILITY GROUP 3o7

The Addielou parts of the Freestone-Addielou complex, 0 to 1 percent slopes, and the Kullit-Addielou complex, 1 to 3 percent slopes, are the only soils in this group. They are loamy, moderately well drained soils on uplands. Permeability is moderately slow, and available water capacity is medium. Slopes are nearly level to gently sloping.

Pines and hardwoods are the principal trees that grow on these soils. Open areas become covered with vines and shrubs. Weeding is needed to release seedlings for normal growth.

Figure 16.—**Loblolly pine along road on Kullit-Addielou complex, 1 to 3 percent slopes.**

WOODLAND SUITABILITY GROUP 3c2

In this group are loamy, well-drained soils on uplands. Permeability is very slow, and available water capacity is high. Slopes are nearly level to strongly sloping.

Pines are the principal trees that grow on these soils. The supply of moisture is sufficient to cause moderate plant competition. Some weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 3s2

In this group are sandy, well drained soils on uplands. Permeability is moderately rapid to moderate, and available water capacity is low. Slopes are gently sloping to sloping.

Pines are the principal trees that grow on these soils. The supply of moisture is sufficient to cause moderate plant competition. Some weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 3w6

In this group are loamy to clayey, moderately well drained soils on bottom lands. Permeability is very slow, and available water capacity is high. Slopes are nearly level.

Hardwoods and a few scattered pines are the principal trees that grow on these soils. The supply of moisture is sufficient to cause moderate plant competition from unwanted trees, shrubs, and vines. When openings are made in the canopy, weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 3w8

In this group are loamy, moderately well drained and somewhat poorly drained soils on uplands and terraces. Permeability is slow to very slow, and available water capacity is medium. Slopes are nearly level.

Pines and hardwood trees grow on these soils. The supply of moisture is sufficient to cause moderate plant competition from unwanted trees, shrubs, and vines. When openings are made in the canopy, weeding is needed to release young seedlings for normal growth. There is a hazard of damage to tree roots if areas are logged during the wet season.

WOODLAND SUITABILITY GROUP 3w9

The Wrightsville part of the Wrightsville-Rodessa complex is the only soil in this group. It is a loamy, poorly drained soil on uplands and terraces. Permeability is very slow, and available water capacity is high. Slopes are nearly level.

Pines and hardwood trees grow on these soils. The supply of moisture is sufficient to cause slight to moderate competition from unwanted trees, shrubs, and vines. When openings are made in the canopy, weeding is needed to release seedlings for normal growth.

WOODLAND SUITABILITY GROUP 4c2

In this group are loamy, moderately well drained to somewhat poorly drained soils on uplands. Permeability is very slow, and available water capacity is high. Slopes are gently sloping to strongly sloping.

Pines are the principal trees that grow on these soils. The supply of moisture is sufficient to cause slight to moderate plant competition.

WOODLAND SUITABILITY GROUP 5c2

Bryarly clay loam, 1 to 5 percent slopes, is the only soil in this group. It is a loamy, moderately well drained soil on uplands. Permeability is very slow, and available water capacity is high. Slopes are gently sloping.

Pines are the principal trees that grow on this soil. The supply of moisture is sufficient to cause slight plant competition.

Woodland Grazing

About half of the woodland in Red River County provides grazing for cattle and furnishes forest products. Cattle consists primarily of cows and calves for beef production.

The principal source of forage for cattle is improved pasture. Many farms and ranches, however, also have woodland that contributes significantly to the total forage needs of livestock in the county. Woodlands have an understory plant community of grasses, sedges, forbs, and shrubs that are valuable for grazing. These plants receive no cultural treatment. Their composition and production is largely determined by the kind of soil, soil moisture situation, overstory canopy, and grazing management. These woodlands can be grazed by livestock, big game animals, and other wildlife without significantly affecting other forest values. More than 150,000 acres of commercial forest in Red River County is grazed by domestic livestock.

Good production of forage on grazed woodland is obtained primarily by regulating the season of use, intensity of grazing, and overstory canopy.

The soils suited to woodlands in Red River County have been placed in grazing groups. These groups assist land users in the evaluation of their woodland for secondary uses, such as the production of forage for livestock and wildlife.

A grazing group is a kind of forest land distinguished by its potential to produce native plants suitable for grazing and wildlife use. The criteria for differentiating grazing groups are based on significant differences in the kinds and proportions of understory plants in the climax plant community and significant differences in the yield of understory vegetation in the climax plant community.

In evaluating the potential for grazing on any wooded soil, the percentage of canopy is a very significant factor. There are four overstory canopy classes—open, sparse, medium, and dense. An *open* canopy has less than 20 percent of the ground shaded at noon; a *sparse* canopy has 21 to 35 percent of the ground shaded at noon; a *medium* canopy has 36 to 55 percent of the ground shaded at noon; and a *dense* canopy has more than 55 percent of the ground shaded at noon. Herbaceous understory is almost eliminated where the canopy is dense.

The density of the understory affects its availability to livestock and wildlife. Where the canopy is open, about 90 percent of the understory is available; where the canopy is medium, about 75 percent is available; and where the canopy is dense, about 60 percent is available. The rest of the understory consists of woody vegetation that is not suited to grazing.

Woodland grazing groups

Management of woodland grazing can be planned more effectively if soils are grouped according to those characteristics that affect the growth of understory vegetation. For this reason, the soils of Red River County have been placed in seven woodland grazing groups. The groups are described, and the primary species grazed by cattle are listed in the following pages. The effects of heavy grazing on the vegetation and the potential annual vegetative yields under different densities of canopy cover are also given.

CLAYEY BOTTOMLAND WOODLAND GRAZING GROUP

In this group are loamy to clayey, poorly drained to moderately well drained soils on bottom lands. Permeability is very slow, and available water capacity is high.

Primary species grazed by cattle include sedges, Virginia wildrye, beaked panicums, low panicums, low paspalums, longleaf uniola, switchcane, and eastern gamagrass.

If these soils are continuously and heavily grazed, the woody understory increases and herbaceous plants decrease. Woody vegetation includes hawthorn, greenbriar, cow-itch vine, rattan, and eastern hornbean. A dense canopy cover eliminates nearly all herbaceous plants.

The potential annual acre yield of air-dry herbage ranges from 2,000 pounds where canopy cover is dense to as much as 8,000 pounds where canopy cover is open. The mean annual production is about 2,500 pounds where canopy cover is medium.

FLATWOOD WOODLAND GRAZING GROUP

In this group are loamy to clayey, poorly drained to somewhat poorly drained soils on terraces and uplands. Permeability is very slow, and available water capacity is high.

Primary species grazed by cattle include switchgrass, sedges, Florida paspalum, indiangrass, big bluestem, little bluestem, and lespedezas.

If these soils are continuously and heavily grazed, the trees and underbrush increase to resemble a scrub forest. This scrub vegetation includes myrtle, greenbriar, honeysuckle, peppervine, longleaf uniola, and low panicums.

The potential annual acre yield of air-dry herbage ranges from 1,000 pounds where canopy cover is dense to as much as 6,000 pounds where canopy cover is open. The mean annual production is about 2,000 pounds where canopy cover is medium.

LOAMY BOTTOMLAND WOODLAND GRAZING GROUP

In this group are loamy, somewhat poorly drained to well-drained soils on bottom lands. Permeability is moderately rapid to very slow, and available water capacity is medium to high.

Primary species grazed by cattle include Florida paspalums, switchgrass, sedges, beaked panicums, longleaf uniola, switchcane, Virginia wildrye, lespedeza, and tickclover.

If these soils are heavily and continuously grazed, the woody understory increases, and herbaceous plants decrease. Woody vegetation includes elm, locust, hawthorn, eastern hornbean, rattan, and greenbriar.

The potential annual acre yield of air-dry herbage ranges from about 2,000 pounds where canopy cover is dense to as much as 5,000 pounds where canopy cover is open. The mean annual production is about 2,500 pounds where canopy cover is medium.

SANDY WOODLAND GRAZING GROUP

In this group are sandy, well-drained soils on terraces and uplands. Permeability is moderate to moderately rapid, and available water capacity is low.

Primary species grazed by cattle include longleaf uniola, purpletop, arrow-feather, little bluestem, low panicums, low paspalums, lespedezas, and tickclover.

If these soils are continuously and heavily grazed, the woody understory increases and herbaceous plants decrease. Woody vegetation includes hawthorn, eastern redcedar, winged elm, sumac, greenbriar, sassafras, grape, and American beautyberry.

The potential annual acre yield of air-dry herbage ranges from about 1,600 pounds where canopy cover is dense to as much as 5,000 pounds where canopy cover is open. The mean annual production is about 1,600 pounds where canopy cover is medium.

SANDY BOTTOMLAND WOODLAND GRAZING GROUP

In this group are sandy, well-drained soils on bottom lands. Permeability is rapid, and available water capacity is low.

Primary species grazed by cattle include low paspalums, low panicums, and annual weeds and grasses.

If these soils are continuously grazed, the woody understory vegetation increases, and herbaceous vegetation decreases. Woody vegetation consists almost entirely of sandbar willow.

The potential annual acre yield of air-dry herbage ranges from about 300 pounds where canopy cover is dense to as much as 2,000 pounds where canopy cover is open. The mean annual production is about 1,500 pounds where canopy cover is medium.

SANDY LOAM WOODLAND GRAZING GROUP

In this group are loamy, well-drained to somewhat poorly drained soils. Permeability is moderately slow to very slow, and available water capacity is medium to high.

Primary species grazed by cattle include little bluestem, beaked panicums, indiangrass, purpletop, and longleaf uniola.

If these soils are continuously and heavily grazed, the woody understory increases and herbaceous plants decrease. Woody vegetation includes American beautyberry, sumac, eastern redcedar, persimmon, dogwood,

rattan, greenbriar, osage-orange, eastern hornbean, and hawthorn.

The potential annual acre yield of air-dry herbage ranges from about 1,500 pounds where canopy cover is dense to as much as 6,000 pounds where canopy cover is open. The mean annual production is about 2,000 pounds where canopy cover is medium.

TIGHT SANDY LOAM WOODLAND GRAZING GROUP

In this group are loamy, well-drained to somewhat poorly drained soils on uplands. Permeability is very slow, and available water capacity is high.

Primary species grazed by cattle include little bluestem, beaked panicums, low paspalums, low panicums, purpletop, longleaf uniola, Florida paspalum, and indiangrass.

If these soils are continuously and heavily grazed, the woody understory increases and herbaceous plants decrease. Woody vegetation includes sumac, winged elm, pricklyash, American beautyberry, dogwood, hawthorn, and eastern redcedar.

The potential annual acre yield of air-dry herbage ranges from 1,500 pounds where canopy cover is dense to as much as 3,500 pounds where canopy cover is open. The mean annual production is about 1,500 pounds where canopy cover is medium.

Wildlife

Soils directly influence the kinds and amounts of vegetation and the amounts of water available, and in this way they indirectly influence the kinds of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are (1) thickness of soil useful to crops, (2) surface texture, (3) available water capacity to a depth of 40 inches, (4) wetness, (5) surface stoniness or rockiness, (6) hazard of flooding, (7) slope, and (8) permeability of the soil to air and water.

In table 4 soils of Red River County are rated for production of six elements of wildlife habitat and for three groups or kinds of wildlife. The ratings indicate relative suitability for various elements.

A rating of *good* means that the element of wildlife habitat is easily created, improved, and maintained. There are few or no limitations to management of the habitat, and satisfactory results are assured.

A rating of *fair* means that the element of wildlife habitat can be created, improved, or maintained in most places. Moderate intensity of management and fairly frequent attention may be required for satisfactory results.

A rating of *poor* means that limitations for the element of wildlife habitat are severe. Habitats can be created, improved, or maintained in most places, but management is difficult and requires intensive effort.

A rating of *very poor* means that limitations for the element of wildlife habitat are very severe and that unsatisfactory results are to be expected. It is either impossible or impractical to create, improve, or maintain habitats on soils in this category.

Each soil is rated in table 4 according to its suitability for producing various kinds of plants and other elements that make up wildlife habitat. The ratings take into account mainly the characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of soils, or present distribution of wildlife and people. For this reason, selection of a site for development as a habitat for wildlife requires inspection at the site. The elements of wildlife habitat rated in table 4 are briefly described in the following paragraphs.

Grain and seed crops.—These crops are annual grain-producing plants such as corn, sorghum, millet, and soybeans.

Grasses and legumes.—This group consists of domestic grasses and legumes that are established by planting. They provide food and cover for wildlife. Grasses include bahiagrass, ryegrass, and panicgrass; legumes include annual lespedeza, shrub lespedeza, and other clovers.

Wild herbaceous upland plants.—This group consists of native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Beggarweed, perennial lespedeza, wild bean, pokeweed, and cheatgrass are typical examples. On rangeland, typical plants are bluestem, grama, perennial forbs, and legumes.

Hardwood trees, shrubs, and vines.—These plants are nonconiferous trees, shrubs, and woody vines that produce wildlife food in the form of fruits, nuts, buds, catkins, or browse. Such plants commonly grow in their natural environment, but they may be planted and developed through wildlife management programs. Typical species in this category are oak, beech, cherry, dogwood, maple, viburnum, grape, honeysuckle, greenbrier, and silverberry.

Wetland food and cover plants.—This group consists of annual and perennial herbaceous plants that grow wild on moist and wet sites. They furnish food and cover mostly for wetland wildlife. Typical examples of plants are smartweed, wild millet, spikerush and other rushes, sedges, burreed, tearthumb, and aneilema. Submerged and floating aquatics are not included in this category.

Shallow-water developments.—These developments are impoundments or excavations for controlling water, generally not more than 5 feet deep, to create habitats that are suitable for waterfowl. Some are designed to be drained, planted, and then flooded; others are permanent impoundments that grow submersed aquatics.

Table 4 rates soils according to their suitability as habitat for the three kinds of wildlife in the county—open-land, woodland, and wetland. These ratings are related to ratings made for the elements of wildlife habitat. For example, soils rated unsuited to shallow-water developments are rated unsuited to wetland wildlife. The kinds of wildlife rated in table 4 are briefly described in the following paragraphs.

Open-land wildlife.—This group consists of birds and mammals that normally live in meadows, pastures, and other open areas where grasses, herbs, and shrubby plants grow. Quail, doves, meadowlarks, field sparrows, cottontail rabbits, and foxes are typical examples of open-land wildlife.

TABLE 4.—*Suitability of soils for elements of wildlife habitat and kinds of wildlife*

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood trees, shrubs, and vines	Wetland food and cover plants	Shallow-water developments	Open-land	Woodland	Wetland
Addielou Mapped only in complexes with Freestone and Kullit soils.	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Annona: AfB For Freestone part, see Freestone series.	Fair	Good	Good	Good	Fair	Poor	Good	Good	Poor.
Austin: AuB	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Poor	Very poor.
Bernaldo: BeB For Elysian part, see Elysian series.	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Bryarly: BrC	Fair	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Burleson: BuA, BuB	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Poor.
Crockett: CrB	Fair	Good	Good	Fair	Poor	Poor	Good	Fair	Poor.
Cuthand: CuD2	Poor	Fair	Good	Fair	Poor	Very poor	Fair	Fair	Very poor.
Deport: DaB	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Poor.
Desha: DeA, DeB	Fair	Fair	Fair	Good	Poor	Fair	Fair	Good	Poor.
Ellis: EsC	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Poor	Very poor.
Elysian Mapped only in complexes with Bernaldo, Muldrow, and Whakana soils.	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Ferris: FeD2	Poor	Fair	Fair	Poor	Poor	Very poor	Fair	Poor	Very poor.
Freestone: FrA For Addielou part, see Addielou series.	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Gladewater: Gd, Gf	Poor	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair.
Hapludalfs: HaB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Houston Black: HoB	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Poor	Very poor.
Kaufman:									
Ka	Fair	Fair	Fair	Good	Poor	Fair	Fair	Good	Poor.
Kb	Very poor	Poor	Fair	Good	Poor	Fair	Poor	Fair	Poor.
Kenney: KeD	Poor	Fair	Fair	Poor	Poor	Very poor	Fair	Poor	Very poor.
Kiomatia: Ko	Very poor	Poor	Poor	Poor	Poor	Very poor	Poor	Poor	Very poor.
Kullit: KuB For Addielou part, see Addielou series.	Good	Good	Good	Good	Poor	Very poor	Good	Good	Poor.
Mabank: MaA	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
McKamie:									
McC	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
McE	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Morse: MoD2	Poor	Fair	Fair	Good	Poor	Very poor	Fair	Good	Very poor.

TABLE 4.—*Suitability of soils for elements of wildlife habitat and kinds of wildlife*—Continued

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood trees, shrubs, and vines	Wetland food and cover plants	Shallow-water developments	Open-land	Woodland	Wetland
Muldrow: Mu, Mx. For Elysian part of Mx, see Elysian series.	Fair	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Nahatche: Na	Very poor.	Poor	Fair	Good	Fair	Fair	Poor	Fair	Fair.
Oklared: Of, Ok	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Panola: Pa	Poor	Fair	Fair	Good	Poor	Fair	Fair	Good	Poor.
Redlake:									
Rc	Fair	Fair	Fair	Good	Poor	Poor	Fair	Good	Poor.
Rd	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
Rodessa. Mapped only in a complex with Wrightsville soils.	Poor	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
Roebuck variant: Rf	Poor	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair.
Rosalie: RsC	Poor	Fair	Good	Fair	Poor	Very poor.	Fair	Fair	Very poor.
Thenas: Th	Very poor.	Poor	Good	Good	Poor	Poor	Poor	Good	Poor.
Trinity:									
Tr	Fair	Fair	Fair	Good	Poor	Fair	Fair	Good	Poor.
Ts	Very poor.	Poor	Fair	Good	Poor	Fair	Poor	Fair	Poor.
Varro: Va	Very poor.	Poor	Fair	Good	Poor	Very poor.	Poor	Fair	Very poor.
Vesey:									
VeD	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
VeF	Poor	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Waskom: Wa	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Whakana:									
WhD	Fair	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WkA. For Elysian part, see Elysian series.	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Woodtell:									
WoC	Fair	Good	Good	Good	Poor	Poor	Good	Good	Poor.
WoE	Poor	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Wrightsville: Wr. For Rodessa part, see Rodessa series.	Poor	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.

Woodland wildlife.—This group consists of birds and mammals that normally live in wooded areas of hardwood trees, coniferous trees, and shrubs. Woodcocks, thrushes, wild turkeys, vireos, deer, squirrels, and raccoons are typical examples of woodland wildlife.

Wetland wildlife.—This group consists of birds and mammals that normally live in wet areas, marshes, and swamps. Ducks, geese, rails, shore birds, herons, minks, and muskrats are typical examples of wetland wildlife.

Recreational Development

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 5 the soils of Red River County are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails.

In table 5 the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A *slight* limitation means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, design, or special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

Camp areas are used intensively for tents and small camp trailers and accompanying activities of outdoor living. Little preparation of the site, other than shaping and leveling for tent and parking areas, is required. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best suited soils have gentle slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm when wet but not dusty when dry.

Picnic areas are attractive natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best suited soils are firm when wet but not dusty when dry; are free of flooding during the season of use; and do not have slopes or stoniness that greatly increases cost of leveling sites or of building access roads.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best suited soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm when wet but not dusty when dry. If grading and leveling are required, depth to rock is important.

Paths and trails are used for local and cross-country travel by foot or on horseback. Design and layout should require little or no cutting and filling. The best suited soils are at least moderately well drained, firm when wet but not dusty when dry, flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Engineering Uses of the Soils [5]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among the soil properties that are highly important in engineering are permeability, strength, compaction characteristics, drainage condition, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 6, 7, and 8, which show, respectively, several estimated soil properties significant in engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this survey, can be used to make interpretations in addition to those given in tables 5 and 7, and it also can be used to make other useful maps.

This information, however, does not eliminate the need for further investigation at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths of more than 6 feet. Also, inspection of sites, especially of small sites, is needed because many mapped areas of a given mapping unit may contain small areas of other kinds of soil that have strongly contrasting prop-

[5] BEN J. PECENA, civil engineer, Soil Conservation Service, assisted in preparing this section.

TABLE 5.—*Degree of limitation and major factors affecting recreational uses*

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Addielou Mapped only in complexes with Freestone and Kullit soils.	Slight	Slight	Slight	Slight.
Annona: AfB For Freestone part, see Freestone series.	Severe: percs slowly.	Moderate: wetness	Severe: percs slowly.	Moderate: wetness.
Austin: AuB	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Bernaldo: BeB For Elysian part, see Elysian series.	Slight	Slight	Slight	Slight.
Bryarly: BrC	Severe: percs slowly.	Moderate: too clayey.	Severe: percs slowly.	Moderate: too clayey.
Burleson: BuA, BuB	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Crockett: CrB	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
Cuthand: CuD2	Slight	Slight	Moderate: slope	Slight.
Deport: DaB	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Desha: DeA, DeB	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Ellis: EsC	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Elysian Mapped only in complexes with Bernaldo, Muldrow, and Whakana soils.	Slight	Slight	Slight	Slight.
Ferris: FeD2	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Freestone: FrA For Addielou part, see Addielou series.	Moderate: wetness	Moderate: wetness	Moderate: wetness	Slight.
Gladewater: Gd, Gf	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Hapludalfs: HaB	Slight	Slight	Slight	Slight.
Houston Black: HoB	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Kaufman: Ka, Kb	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Kenney: KeD	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Kiomatia: Ko	Severe: floods	Severe: floods	Severe: floods	Severe: floods.
Kullit: KuB For Addielou part, see Addielou series.	Moderate: wetness	Slight	Moderate: wetness; slope.	Slight.
Mabank: MaA	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate wetness.
McKamie:				
McC	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
McE	Severe: percs slowly.	Moderate: slope	Severe: slope; percs slowly.	Slight.
Morse: MoD2	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Muldrow: Mu, Mx For Elysian part of Mx, see Elysian series.	Severe: percs slowly; wetness.	Moderate: wetness	Severe: wetness; percs slowly.	Moderate: wetness.
Nahatche: Na	Severe: floods	Moderate: floods	Severe: floods	Moderate: floods.
Oklared:				
Of	Slight	Slight	Slight	Slight.
Ok	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.

TABLE 5.—*Degree of limitation and major factors affecting recreational uses*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Panola: Pa	Severe: wetness; too clayey.	Severe: wetness; too clayey.	Severe: wetness; too clayey.	Severe: wetness; too clayey.
Redlake:				
Rc	Severe: too clayey; percs slowly.	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Rd	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
Rodessa Mapped only in a complex with Wrightsville soils.	Severe: percs slowly; wetness.	Moderate: wetness	Severe: percs slowly; wetness.	Moderate: wetness.
Roebuck variant: Rf	Severe: percs slowly; wetness.	Severe: wetness	Severe: percs slowly; wetness.	Severe: wetness.
Rosalie: RsC	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Thenas: Th	Severe: floods	Severe: floods	Severe: floods	Moderate: floods.
Trinity:				
Tr	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Ts	Severe: floods; too clayey.	Severe: floods; too clayey.	Severe: floods; too clayey.	Severe: floods; too clayey.
Varro: Va	Severe: floods	Severe: floods	Severe: floods	Severe: floods.
Vesey:				
VeD	Slight	Slight	Moderate: slope	Slight.
VeF	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Waskom: Wa	Moderate: wetness	Moderate: wetness	Moderate: wetness	Slight.
Whakana:				
WhD	Slight	Slight	Moderate: slope	Slight.
WkA For Elysian part, see Elysian series.	Slight	Slight	Slight	Slight.
Woodtell:				
WoC	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
WoE	Severe: percs slowly.	Moderate: slope	Severe: slope; percs slowly.	Slight.
Wrightsville: Wr For Rodessa part, see Rodessa series.	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.

TABLE 6.—*Estimates of soil*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The instructions for referring to other series that appear in the first column of

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	Dominant USDA texture	Classification	
		Bedrock	Seasonal high water table			Unified	AASHTO
		Inches	*Inches*	*Inches*			
Addielou	B	>60	40–60	0–28	Fine sandy loam	SM, SM-SC, ML or CL-ML	A–4
Mapped only in complexes with Freestone and Kullit soils.				28–60	Sandy clay loam	SC or CL	A–6
				60–90	Clay	CH	A–7–6
*Annona: AfB	D	>60	24–40	0–10	Loam	ML or SM	A–4
For Freestone part, see Freestone series.				10–40	Clay	CH	A–7–6
				40–95	Clay	CH, CL	A–7–6
Austin: AuB	C	24–40	>60	0–50	Silty clay	CH	A–7–6
*Bernaldo: BeB	B	>60	48–72	0–10	Fine sandy loam	ML, SM, CL-ML, or SM-SC	A–4
For Elysian part, see Elysian series.				10–50	Sandy clay loam	CL	A–6
				50–93	Clay loam	CL, SC	A–6
Bryarly: BrC	D	>60	>60	0–3	Clay loam	CL	A–7–6 or A–6
				3–46	Clay	CH	A–7–6
				46–81	Clay	CH	A–7–6
Burleson: BuA, BuB	D	>60	>60	0–87	Clay	CH	A–7–6
Crockett: CrB	D	40–55	>60	0–10	Loam	CL, ML, or CL-ML	A–4
				10–50	Clay	CH or CL	A–7–6
				50–70	Partially weathered shale.		
Cuthand: CuD2	B	25–40	>60	0–25	Loam	CL or CL-ML	A–4 or A–6
				25–50	Fissile shale.		
Deport: DaB	D	40–65	12–40	0–57	Clay	CH	A–7–6
				57–68	Shale.		
Desha: DeA, DeB	D	>60	0–15	0–96	Clay	CH	A–7–6
Ellis: EsC	D	20–40	>60	0–31	Clay	CH	A–7–6
				31–36	Shale.		
Elysian	B	>60	24–72	0–20	Fine sandy loam	CL-ML, SM-SC, SC, SM, ML, or CL	A–4, A–2, or A–6
Mapped only in complexes with Bernaldo, Muldrow, and Whakana soils.				20–90	Loam	CL-ML or CL	A–4
Ferris: FeD2	D	30–60	>60	0–49	Clay	CH	A–7–6
				49–80	Shale.		
*Freestone: FrA	C	>60	20–38	0–10	Fine sandy loam	CL-ML, ML, SM, SC, CL, or SM-SC	A–4
For Annona series. Addielou part, see Addielou series.				10–38	Sandy clay loam	CL	A–6
				38–48	Clay	CL or CH	A–7–6
				48–76	Clay loam	CL	A–6
Gladewater: Gd, Gf	D	>60	10–20	0–65	Clay	CH	A–7–6

properties significant in engineering

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the this table. The symbol > means greater than; the symbol < means less than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*Inches per hour*	*Inches per inch of soil*	*pH*			
95–100	95–100	70–85	40–55	<25	[1]NP–5	0.6–2.0	0.10–0.15	5.6–7.3	Low	Low	Moderate.
95–100	95–100	80–90	45–65	20–35	11–20	0.2–0.6	0.15–0.16	4.5–6.0	Low	Moderate	Moderate.
100	95–100	90–100	75–95	51–60	25–35	0.06–0.2	0.15–0.20	4.5–5.5	High	High	High.
95–100	95–100	75–95	45–70	<25	NP–3	0.6–2.0	0.13–0.15	4.5–6.5	Low	Low	High.
95–100	95–100	90–100	75–95	51–70	30–45	<0.06	0.15–0.18	4.5–6.0	High	High	High.
95–100	95–100	90–100	75–95	41–55	25–35	<0.06	0.15–0.18	5.6–8.4	High	High	Moderate.
95–100	95–100	80–100	75–95	51–65	25–40	0.2–0.6	0.15–0.20	7.9–8.4	High	High	Low.
100	95–100	90–100	45–65	<25	NP–5	2.0–6.0	0.10–0.15	5.6–6.5	Low	Low	Moderate.
100	100	90–100	51–75	26–40	12–24	0.6–2.0	0.15–0.20	4.5–6.5	Low	Moderate	Moderate.
100	100	90–100	45–65	30–40	12–24	0.6–2.0	0.15–0.20	4.5–6.5	Low	Moderate	Moderate.
100	100	90–100	70–80	40–45	20–30	0.6–2.0	0.15–0.18	4.5–6.5	Moderate	Moderate	Moderate.
100	100	90–100	75–96	60–75	35–48	<0.06	0.15–0.18	4.5–5.5	High	High	Moderate.
98–100	95–100	90–100	75–95	51–76	25–45	<0.06	0.15–0.18	7.4–8.4	High	High	Moderate.
95–100	90–100	80–100	80–97	51–75	30–55	<0.06	0.15–0.18	5.6–8.4	High	High	Low.
95–100	95–100	95–100	51–70	<35	NP–15	0.6–2.0	0.11–0.15	5.6–7.3	Low	Low	Moderate.
95–100	95–100	80–100	65–90	40–55	25–35	<0.06	0.15–0.18	6.1–7.8	High	High	Low.
100	95–100	90–100	80–90	20–35	5–15	0.6–2.0	0.10–0.15	7.9–8.4	Low	Moderate	Low.
95–100	95–100	95–100	90–100	51–75	30–50	<0.06	0.12–0.18	5.6–8.4	High	High	Low.
100	100	95–100	95–100	60–85	40–70	<0.06	0.17–0.20	6.1–7.8	High	High	Low.
95–100	95–100	90–100	90–100	51–70	25–40	<0.06	0.12–0.18	6.6–8.4	High	High	Low.
100	100	50–70	30–60	<26	NP–12	0.6–2.0	0.10–0.13	5.6–6.5	Low	Low	Moderate.
100	100	90–100	55–85	20–30	4–10	0.6–2.0	0.12–0.16	4.5–6.0	Low	Low	High.
95–100	95–100	80–95	75–95	51–70	35–50	<0.06	0.15–0.18	7.9–8.4	High	High	Low.
100	100	70–85	40–55	20–30	2–10	0.6–2.0	0.10–0.15	5.1–7.3	Low	Low	Moderate.
100	95–100	80–90	51–70	30–40	11–20	0.2–0.6	0.10–0.15	4.5–6.0	Moderate	Moderate	Moderate.
95–100	95–100	80–95	65–85	41–55	26–35	0.06–0.2	0.10–0.15	5.6–6.5	High	Moderate	Moderate.
100	95–100	80–90	51–70	20–30	11–20	0.2–0.6	0.10–0.15	5.6–6.5	Moderate	Moderate	Moderate.
100	100	90–100	75–95	51–60	35–45	<0.06	0.15–0.17	4.5–7.3	High	High	Moderate.

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	Dominant USDA texture	Classification	
		Bedrock	Seasonal high water table			Unified	AASHTO
		Inches	*Inches*	*Inches*			
Hapludalfs: HaB	C	>60	>60	0–7	Fine sandy loam	SM-SC, ML, SM, SC, CL-ML, or CL	A–4
				7–15	Loam	CL-ML, CL	A–4 or A–6
				15–38	Sandy clay loam	CL	A–6 or A–7–6
				38–50	Clay loam	CL	A–6 or A–7–6
				50–60	Stratified fine sandy loam and sandy clay loam.	SC, ML, SM, CL-ML, CL, or SM-SC	A–4
Houston Black: HoB	D	>60	>60	0–69	Clay	CH	A–7–6
				69–72	Shale.		
Kaufman: Ka, Kb	D	>60	10–40	0–70	Clay	CH	A–7–6
Kenney: KeD	A	>60	>60	0–52	Loamy fine sand	SM or SP-SM	A–2
				52–84	Sandy clay loam	SC or CL	A–6
Kiomatia: Ko	A	>60	30–60	0–4	Loamy fine sand	SM	A–4 or A–2–4
				4–60	Stratified fine sand, very fine sandy loam.	SM or SP-SM	A–2–4
*Kullit: KuB For Addielou part, see Addielou series.	B	>60	20–60	0–5	Fine sandy loam	ML or SM	A–2–4, A–4
				5–14	Sandy clay loam	SC or CL	A–4 or A–6
				14–38	Clay loam	SC or CL	A–6
				38–90	Clay	CL	A–7–6
Mabank: MaA	D	>60	6–20	0–6	Fine sandy loam	SC, CL, CL-ML, SM-SC	A–4
				6–90	Clay	CH	A–7–6
McKamie: McC, McE	D	>60	>60	0–9	Loam	ML or CL-ML	A–4
				9–36	Clay	CH or CL	A–7–6
				36–65	Silty clay loam, clay.	CL	A–7–6 or A–6
Morse: MoD2	D	>60	>60	0–84	Clay	CH or MH	A–7–6
*Muldrow: Mu, Mx For Elysian part, see Elysian series.	D	>60	24–72	0–10	Silty clay loam	CL or ML	A–4 or A–6
				10–85	Clay	CL or CH	A–6 or A–7–6
Nahatche: Na	C	>60	10–20	0–50	Clay loam	CL	A–6 or A–7–6
				50–72	Sandy clay loam	CL	A–6 or A–4, A–7–6
Oklared:							
Of	B	>60	>60	0–15	Fine sandy loam	ML, CL-ML, SM, or SM-SC	A–2–4 or A–4
				15–25	Very fine sandy loam.	ML, SM, CL, SC, CL-ML, or SM-SC	A–4
				25–65	Fine sandy loam	ML, SM, CL, SC, CL-ML or SM-SC	A–4 or A–2–4
Ok	B	>60	>60	0–8	Silty clay loam	CL	A–6 or A–7–6
				8–65	Fine sandy loam, very fine sandy loam, loam.	ML, SM, CL, SC, CL-ML, or SM-SC.	A–4
Panola: Pa	D	>60	10–72	0–5	Silty clay	CL	A–6 or A–7–6
				5–83	Clay	CL or CH	A–7–6
Redlake:							
Rc	D	>60	>60	0–40	Clay	CL or CH	A–7–6
				40–55	Clay loam	CL or ML	A–4, A–6, or A–7–6
				55–65	Loam	CL-ML or CL	A–4

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*Inches per hour*	*Inches per inch of soil*	*pH*			
95–100	95–100	90–100	36–60	20–26	2–8	2.0–6.0	0.10–0.15	5.6–6.5	Low	Low	Moderate.
100	100	85–95	60–75	20–30	4–20	0.6–2.0	0.10–0.15	5.6–6.5	Low	Low	Moderate.
95–100	95–100	90–100	51–85	28–46	15–23	0.2–0.6	0.10–0.15	5.6–6.5	Moderate	Moderate	Moderate.
95–100	95–100	90–100	51–85	28–46	15–23	0.2–0.6	0.10–0.15	5.6–6.5	Moderate	Moderate	Moderate.
95–100	95–100	90–100	36–60	20–26	2–8	2.0–6.0	0.10–0.15	6.1–7.3	Low	Low	Moderate.
95–100	95–100	95–100	85–100	55–95	35–80	<0.06	0.15–0.20	7.9–8.4	High	High	Low.
100	100	95–100	90–95	70–80	40–50	<0.06	0.15–0.20	5.6–7.8	High	High	Low.
100	100	50–75	10–20		NP	6.0–20	0.06–0.10	5.1–6.5	Low	Low	Moderate.
100	100	80–90	45–55	25–35	11–19	2.0–6.0	0.10–0.15	5.1–6.5	Low	Low	Moderate.
100	95–100	80–100	30–45	<26	NP–3	0.6–2.0	0.10–0.15	7.9–8.4	Low	Low	Low.
100	95–100	80–90	10–35	<22	NP–3	6.0–20	0.05–0.10	7.9–8.4	Low	Low	Low.
100	100	90–100	30–60	<26	NP–3	2.0–6.0	0.10–0.13	5.1–6.5	Low	Low	Moderate.
100	100	90–100	40–60	20–35	8–15	0.6–2.0	0.12–0.15	4.5–5.5	Low	Moderate	Moderate.
100	100	90–100	40–60	25–35	11–15	0.6–2.0	0.12–0.15	4.5–5.5	Moderate	Moderate	High.
100	100	90–100	51–60	41–49	20–28	0.2–0.6	0.15–0.18	4.5–5.5	Moderate	High	High.
95–100	95–100	80–95	40–60	20–30	4–10	0.6–2.0	0.10–0.15	5.6–7.3	Low	Low	Moderate.
95–100	95–100	95–100	70–85	51–65	30–40	<0.06	0.12–0.15	5.6–8.4	High	High	Low.
100	100	90–100	65–75	<20	NP–7	0.6–2.0	0.16–0.20	5.1–6.5	Low	Low	Moderate.
100	100	95–100	85–95	45–52	23–33	<0.06	0.18–0.20	4.5–6.0	High	High	High.
100	100	95–100	85–95	25–45	12–25	0.2–0.6	0.18–0.20	5.6–7.8	Moderate	Moderate	Low.
100	100	95–100	85–100	51–75	22–35	<0.06	0.15–0.20	7.9–8.4	High	High	Low.
100	100	96–100	80–98	30–43	8–20	0.2–0.6	0.18–0.20	5.6–6.0	Moderate	High	Moderate.
100	100	98–100	85–99	35–65	15–35	<0.06	0.15–0.20	6.1–8.4	High	High	Low.
100	100	90–100	70–80	30–45	15–25	0.6–2.0	0.10–0.15	5.1–7.3	Moderate	Moderate	Moderate.
100	100	85–95	60–70	30–45	10–25	0.6–2.0	0.10–0.15	5.6–6.0	Moderate	High	Moderate.
100	100	90–100	30–60	<26	NP–6	2.0–6.0	0.10–0.15	7.9–8.4	Low	Low	Low.
100	100	90–100	36–60	<30	NP–10	2.0–6.0	0.10–0.15	7.9–8.4	Low	Low	Low.
100	100	90–100	20–90	<30	NP–10	2.0–6.0	0.10–0.15	7.9–8.4	Low	Low	Low.
100	100	100	85–95	35–50	13–26	0.6–2.0	0.15–0.19	7.9–8.4	Moderate	Moderate	Moderate.
100	100	90–100	36–60	<30	NP–10	2.0–6.0	0.10–0.15	7.9–8.4	Low	Low	Low.
100	100	100	85–95	30–40	11–20	0.06–0.2	0.15–0.19	5.1–6.0	High	High	High.
100	100	100	90–98	45–65	20–35	<0.06	0.15–0.18	4.5–7.8	High	High	High.
100	100	100	90–98	45–65	18–35	<0.06	0.15–0.18	7.9–8.4	High	High	Low.
100	100	100	75–95	35–49	10–25	0.2–0.6	0.15–0.19	7.9–8.4	Moderate	High	Low.
100	100	90–100	70–80	20–30	4–10	0.6–2.0	0.10–0.15	7.9–8.4	Low	Moderate	Low.

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	Dominant USDA texture	Classification	
		Bedrock	Seasonal high water table			Unified	AASHTO
		Inches	*Inches*	*Inches*			
Redlake—Cont.							
Rd	D	>60	>60	0–10	Fine sandy loam	ML, SM, CL-ML, or SM-SC	A–4 or A–2–4
				10–42	Clay	CL or CH	A–7–6
				42–60	Fine sandy loam	ML, SM, CL, SC, CL-ML, or SM-SC	A–4
Rodessa	D	>60	24–72	0–31	Loam	CL-ML, ML, or CL	A–4 or A–6
Mapped only in a complex with Wrightsville soils.				31–72	Clay	CL or CH	A–7–6
Roebuck variant: Rf	D	>60	>60	0–96	Clay	CL or CH	A–7–6
Rosalie: RsC	B	>60	40–72	0–31	Loamy fine sand	SP-SM or SM	A–2–4
				31–100	Sandy clay loam	SC or CL	A–6
Thenas: Th	C	>60	14–40	0–8	Fine sandy loam	SM or SM–SC	A–4
				8–14	Very fine sandy loam.	CL-ML or CL	A–4
				14–27	Loam	CL-ML or CL	A–4
				27–72	Fine sandy loam	SM or SM-SC	A–4
Trinity: Tr, Ts	D	>60	>60	0–64	Clay	CH	A–7–6
Varro: Va	B	>60	>60	0–7	Clay loam	CL	A–4 or A–6
				7–60	Clay loam	CL	A–7–6 or A–6
Vesey: VeD, VeF	B	>60	>60	0–24	Fine sandy loam	SM	A–2–4 or A–4
				24–52	Sandy clay loam	CL-ML, SC, SM-SC, or CL	A–4 or A–6
				52–68	Loam, sandy loam	SM or SM–SC	A–2–4 or A–4
Waskom: Wa	C	>60	24–72	0–15	Loam	ML or CL	A–4 or A–6
				15–32	Clay loam	CL	A–7–6
				32–80	Sandy clay loam	CL or SC	A–6 or A–7–6
*Whakana: WhD, WkA	B	>60	>60	0–14	Loam	CL-ML, ML, SM, or SM-SC	A–4
For Elysian part of WkA, see Elysian series.				14–34	Clay loam	CL	A–6
				34–80	Loam, sandy clay loam.	CL, ML, SM, CL-ML, SC, or SM-SC	A–6
Woodtell: WoC, WoE	D	>60	>60	0–6	Fine sandy loam	ML, SM, CL-ML, or SM-SC	A–2–4 or A–4
				6–29	Clay	CH or CL	A–7–6
				29–45	Clay loam	CL, SC, or CH	A–7–6 or A–6
				45–72	Stratified sandy clay loam.		
*Wrightsville: Wr	D	>60	10–40	0–11	Very fine sandy loam.	CL	A–6
For Rodessa part, see Rodessa series.				11–86	Clay	CL or CH	A–7–6

[1] NP=Nonplastic.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Pct		*Inches per hour*	*Inches per inch of soil*	*pH*			
100	100	90–100	30–60	<26	NP–6	2.0–6.0	0.10–0.15	7.9–8.4	Low	Low	Low.
100	100	100	90–98	45–65	18–35	<0.06	0.15–0.18	7.9–8.4	High	High	Low.
100	100	90–100	36–60	<30	NP–10	2.0–6.0	0.10–0.15	7.9–8.4	Low	Moderate	Low.
100	100	85–95	60–75	20–40	3–15	0.6–2.0	0.10–0.15	4.5–6.5	Low	Low	Moderate.
100	100	90–100	75–95	41–60	25–35	<0.06	0.15–0.17	4.5–6.5	High	High	High.
100	100	94–100	90–98	45–65	20–35	<0.06	0.15–0.18	7.9–8.4	High	High	Low.
95–100	85–95	75–85	10–20	<25	NP–3	6.0–20	0.05–0.10	4.5–6.0	Low	Low	High.
100	95–100	80–90	36–55	20–40	11–20	0.6–2.0	0.10–0.15	4.0–5.0	Low	Moderate	High.
100	100	100	36–45	<25	NP–6	2.0–6.0	0.15–0.20	5.6–7.3	Low	Low	Low.
100	100	90–95	51–65	15–30	5–10	2.0–6.0	0.15–0.20	5.6–7.3	Low	Moderate	Low.
100	100	90–100	55–85	20–30	4–10	0.6–2.0	0.15–0.20	5.6–7.3	Low	Moderate	Low.
100	100	85–90	36–45	10–20	3–6	2.0–6.0	0.15–0.20	5.6–7.3	Low	Moderate	Low.
100	98–100	85–100	80–95	51–60	30–40	<0.06	0.15–0.20	7.9–8.4	High	High	Low.
100	100	75–85	51–75	25–40	8–18	2.0–6.0	0.15–0.20	7.9–8.4	Low	Moderate	Low.
100	100	95–100	70–85	30–45	11–20	0.6–2.0	0.15–0.20	7.9–8.4	Moderate	Moderate	Low.
90–100	90–100	70–80	30–49		NP	6.0–20	0.05–0.10	5.6–7.3	Low	Low	Moderate.
95–100	95–100	80–90	36–55	20–35	5–15	0.6–2.0	0.15–0.20	5.1–6.5	Low	Low	Moderate.
90–100	90–100	70–80	30–45	<30	NP–7	2.0–6.0	0.10–0.15	5.1–7.3	Low	Low	Moderate.
100	100	85–95	51–75	30–40	10–15	0.6–2.0	0.15–0.18	6.1–7.3	Low	Low	Low.
100	100	80–100	70–90	45–50	25–30	0.2–0.6	0.15–0.20	6.1–7.8	Moderate	Moderate	Low.
100	100	80–90	36–55	35–45	15–25	0.2–0.6	0.15–0.18	6.1–8.4	Moderate	Moderate	Low.
100	95–100	70–85	40–55	18–30	NP–7	2.0–6.0	0.10–0.15	5.1–7.3	Low	Low	Moderate.
100	100	85–95	51–65	20–35	8–18	0.6–2.0	0.10–0.15	4.5–6.5	Moderate	Moderate	Moderate.
100	95–100	70–85	40–55	<30	NP–12	2.0–6.0	0.10–0.15	4.5–6.0	Low	Low	High.
90–100	85–100	75–90	30–60	<25	NP–4	0.6–2.0	0.10–0.15	4.5–6.5	Low	Low	High.
100	90–100	80–100	60–90	45–55	25–35	0.06	0.15–0.18	4.5–5.5	High	High	High.
100	80–100	75–90	36–85	35–55	15–35	0.06–0.2	0.15–0.20	4.5–5.5	Moderate	High	Moderate.
100	95–100	95–100	75–100	30–40	11–20	0.2–0.6	0.18–0.20	4.5–5.5	Low	High	High.
100	100	95–100	85–100	45–60	25–35	0.06–0.2	0.15–0.20	4.5–5.5	High	High	High.

TABLE 7.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The instructions for referring to other series

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill [1]
Addielou Mapped only in complexes with Freestone and Kullit soils.	Moderate: percs slowly; wetness.	Moderate: slope; wetness.	Moderate: wetness.	Slight	Severe: wetness.
*Annona: AfB For Freestone part, see Freestone series.	Severe: percs slowly; wetness.	Severe: wetness.	Severe: wetness.	Severe: shrink-swell.	Severe: too clayey.
Austin: AuB	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Severe: shrink-swell.	Severe: depth to rock.
*Bernaldo: BeB For Elysian part, see Elysian series.	Moderate: wetness.	Moderate: slope; seepage.	Moderate: wetness.	Moderate: low strength.	Slight
Bryarly: BrC	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Burleson:					
BuA	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
BuB	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Crockett: CrB	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Cuthand: CuD2	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Slight	Severe: depth to rock.
Deport: DaB	Severe: percs slowly; wetness.	Severe: wetness.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Desha:					
DeA	Severe: percs slowly; wetness.	Severe: wetness.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
DeB	Severe: percs slowly; wetness.	Severe: slope; wetness.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Ellis: EsC	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Elysian Mapped only in complexes with Bernaldo, Muldrow, and Whakana.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Ferris: FeD2	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
*Freestone: FrA For Addielou part, see Addielou series.	Severe: percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Severe: wetness.

interpretations

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the that appear in the first column of this table]

Degree and kind of limitation for—(cont.)			Suitability as source of—		Soil features affecting—		
Local roads and streets	Pond reservoir areas	Dikes, levees, and other embankments	Road fill	Topsoil	Drainage for crops and pasture	Waterways	Terraces and diversions
Moderate: low strength.	Moderate: seepage.	Moderate: piping.	Fair: low strength.	Good	Not needed	Slope	Complex slope.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Fair: thin layer.	Favorable	Slope	Complex slope.
Severe: shrink-swell.	Severe: depth to rock.	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Favorable	Favorable.
Moderate: low strength.	Moderate: seepage.	Moderate: piping; erosion.	Fair: low strength.	Fair: thin layer.	Not needed	Slope	Complex slope.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Percs slowly	Percs slowly.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Favorable	Favorable.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Favorable	Favorable.
Severe: shrink-swell.	Slight	Moderate: unstable fill.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Percs slowly	Percs slowly.
Moderate: low strength.	Severe: depth to bedrock.	Moderate: piping; low strength.	Fair: low strength.	Poor: excess lime.	Not needed	Erodes easily	Depth to rock.
Severe: shrink-swell; low strength.	Slight	Moderate: compressible; low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Favorable	Favorable.
Severe: shrink-swell.	Slight	Moderate: compressible; low strength.	Poor: shrink-swell.	Poor: too clayey.	Favorable	Wetness	Not needed.
Severe: shrink-swell.	Slight	Moderate: compressible; low strength.	Poor: shrink-swell.	Poor: too clayey.	Favorable	Wetness	Not needed.
Severe: shrink-swell; low strength.	Slight	Moderate: compressible; low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Percs slowly	Percs slowly.
Slight	Moderate: seepage.	Moderate: piping.	Fair: low strength.	Good	Not needed	Slope	Not needed.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Erodes easily	Slope.
Severe: low strength.	Slight	Moderate: piping.	Poor: shrink-swell.	Fair: thin layer.	Favorable	Wetness	Wetness.

TABLE 7.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill[1]
Gladewater: Gd	Severe: percs slowly.	Severe: wetness.	Severe: too clayey; wetness.	Severe: shrink-swell; wetness.	Severe: wetness.
Gf	Severe: percs slowly; floods.	Severe: wetness; floods.	Severe: wetness; floods.	Severe: shrink-swell; floods.	Severe: wetness; floods.
Hapludalfs: HaB	Slight	Moderate: seepage.	Slight	Moderate: shrink-swell.	Slight
Houston Black: HoB	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Kaufman: Ka	Severe: wetness.	Severe: wetness.	Severe: too clayey; wetness.	Severe: shrink-swell; wetness.	Severe: too clayey.
Kb	Severe: wetness; floods.	Severe: floods; wetness.	Severe: wetness; floods; too clayey.	Severe: shrink-swell; wetness; floods.	Severe: wetness; floods; too clayey.
Kenney: KeD	Slight	Severe: seepage.	Severe: cutbanks cave.	Slight	Moderate: too sandy.
Kiomatia: Ko	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods
*Kullit: KuB For Addielou part, see Addielou series.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness; shrink-swell.	Moderate: wetness.
Mabank: MaA	Severe: percs slowly; wetness.	Severe: wetness.	Severe: too clayey; wetness.	Severe: shrink-swell; wetness.	Severe: too clayey; wetness.
McKamie: McC	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
McE	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
Morse: MoD2	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.
*Muldrow: Mu, Mx For Elysian part of Mx, see Elysian series.	Severe: percs slowly; wetness.	Moderate: wetness.	Severe: too clayey; wetness.	Severe: shrink-swell.	Severe: too clayey; wetness.
Nahatche: Na	Severe: wetness; floods.	Severe: wetness; floods.	Severe: wetness; floods.	Severe: wetness; floods.	Severe: wetness; floods.
Oklared: Of, Ok	Slight	Severe: seepage.	Slight	Slight	Slight
Panola: Pa	Severe: percs slowly; wetness.	Slight	Severe: too clayey; wetness.	Severe: shrink-swell; wetness.	Severe: too clayey; wetness.
Redlake: Rc, Rd	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.

interpretations—Continued

Degree and kind of limitation for—(cont.)			Suitability as source of—		Soil features affecting—		
Local roads and streets	Pond reservoir areas	Dikes, levees, and other embankments	Road fill	Topsoil	Drainage for crops and pasture	Waterways	Terraces and diversions
Severe: shrink-swell; wetness.	Slight	Moderate: compressible.	Poor: shrink-swell; wetness.	Poor: too clayey; wetness.	Percs slowly	Wetness	Not needed.
Severe: shrink-swell; wetness.	Slight	Moderate: compressible.	Poor: shrink-swell; wetness.	Poor: too clayey; wetness.	Floods	Floods	Not needed.
Severe: low strength.	Moderate: seepage.	Moderate: piping.	Poor: low strength.	Fair: thin layer.	Not needed	Not needed	Not needed.
Severe: shrink-swell; low strength.	Slight	Severe: compressible; shrink-swell.	Poor: too clayey; shrink-swell.	Poor: too clayey.	Not needed	Favorable	Favorable.
Severe: shrink-swell.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell.	Poor: too clayey.	Percs slowly	Wetness	Not needed.
Severe: shrink-swell.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell.	Poor: too clayey.	Floods; wetness.	Floods; wetness.	Not needed.
Slight	Severe: seepage.	Severe: seepage.	Good	Poor: too sandy.	Not needed	Droughty	Not needed.
Severe: floods	Severe: seepage.	Severe: seepage.	Good	Poor: too sandy.	Floods	Floods	Not needed.
Moderate: low strength; shrink-swell.	Slight	Moderate: compressible.	Fair: low strength.	Fair: thin layer.	Slope	Slope	Slope.
Severe: low strength; shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: thin layer.	Favorable	Percs slowly	Percs slowly.
Severe: shrink-swell; low strength.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell; low strength.	Poor: thin layer.	Not needed	Percs slowly	Percs slowly.
Severe: shrink-swell; low strength.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell; low strength.	Poor: thin layer.	Not needed	Slope	Percs slowly; slope.
Severe: low strength; shrink-swell.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Slope; erodes easily.	Slope; erodes easily.
Severe: shrink-swell; low strength.	Slight	Moderate: low strength; shrink-swell.	Poor: shrink-swell; low strength.	Fair: too clayey.	Slope; wetness.	Wetness	Not needed.
Severe: floods	Moderate: seepage.	Moderate: low strength.	Poor: low strength.	Fair: too clayey.	Floods	Wetness	Not needed.
Moderate: low strength.	Severe: seepage.	Moderate: piping.	Fair: low strength.	Good	Not needed	Favorable	Not needed.
Severe: shrink-swell.	Slight	Moderate: shrink-swell.	Poor: shrink-swell.	Fair: too clayey.	Percs slowly; wetness.	Percs slowly; wetness.	Not needed.
Severe: shrink-swell.	Slight	Moderate: compressible.	Poor: shrink-swell.	Poor: too clayey.	Percs slowly	Favorable	Not needed.

TABLE 7.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill[1]
Rodessa Mapped only in a complex with Wrightsville series.	Severe: percs slowly; wetness.	Severe: wetness.	Severe: wetness; too clayey.	Moderate: shrink-swell.	Severe: wetness; too clayey.
Roebuck variant: Rf	Severe: percs slowly.	Slight	Severe: too clayey; wetness.	Severe: shrink-swell; wetness.	Severe: too clayey; wetness.
Rosalie: RsC	Severe: wetness.	Moderate: slope.	Moderate: wetness.	Moderate: wetness.	Severe: wetness.
Thenas: Th	Severe: wetness; floods.	Severe: floods; wetness.	Severe: wetness; floods.	Severe: floods; wetness.	Severe: wetness; floods.
Trinity:					
Tr	Severe: percs slowly.	Slight	Severe: too clayey; wetness.	Severe: shrink-swell; wetness.	Severe: too clayey.
Ts	Severe: floods	Severe: floods	Severe: floods; too clayey; wetness.	Severe: floods; shrink-swell; wetness.	Severe: floods; too clayey.
Varro: Va	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods
Vesey:					
VeD	Slight	Severe: seepage.	Slight	Slight	Severe: seepage.
VeF	Moderate: slope.	Severe: seepage.	Moderate: slope.	Moderate: slope.	Severe: seepage.
Waskom: Wa	Severe: percs slowly; wetness.	Severe: wetness.	Severe: wetness.	Moderate: shrink-swell; wetness.	Severe: wetness.
Whakana: WhD, WkA For Elysian part of WkA, see Elysian series.	Moderate: percs slowly.	Severe: seepage.	Slight	Moderate: shrink-swell.	Slight
Woodtell:					
WoC	Severe: percs slowly.	Moderate: slope.	Moderate: wetness.	Severe: shrink-swell.	Severe: too clayey.
WoE	Severe: percs slowly.	Severe: slope	Moderate: wetness.	Severe: shrink-swell.	Severe: too clayey.
*Wrightsville: Wr For Rodessa part, see Rodessa series.	Severe: wetness.	Severe: wetness.	Severe: too clayey; wetness.	Severe: shrink-swell; wetness.	Severe: too clayey; wetness.

[1] Onsite study is needed of the deep underlying strata, the water table, and the hazards of aquifer pollution and drainage into ground water in landfill deeper than 5 or 6 feet.

interpretations—Continued

Degree and kind of limitation for—(cont.)			Suitability as source of—		Soil features affecting—		
Local roads and streets	Pond reservoir areas	Dikes, levees, and other embankments	Road fill	Topsoil	Drainage for crops and pasture	Waterways	Terraces and diversions
Severe: shrink-swell.	Slight	Moderate: piping; shrink-swell.	Poor: shrink-swell.	Good	Percs slowly	Slope	Not needed.
Severe: shrink-swell; wetness.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell; wetness.	Poor: too clayey; wetness.	Percs slowly; wetness.	Wetness	Not needed.
Moderate: low strength.	Moderate: seepage.	Moderate: piping.	Fair: low strength.	Poor: too sandy.	Not needed	Droughty	Too sandy.
Severe: floods	Moderate: seepage.	Moderate: piping.	Good	Good	Floods	Wetness	Not needed.
Severe: shrink-swell.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell.	Poor: too clayey.	Percs slowly	Favorable	Not needed.
Severe: floods, shrink-swell.	Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell.	Poor: too clayey.	Floods	Floods	Not needed.
Severe: floods	Moderate: seepage.	Moderate: piping.	Fair: low strength.	Fair: too clayey.	Floods	Floods	Not needed.
Slight	Severe: seepage.	Moderate: piping.	Fair: low strength.	Good	Not needed	Slope	Slope.
Moderate: slope.	Severe: seepage.	Moderate: piping.	Fair: low strength; slope.	Good	Not needed	Slope	Slope.
Severe: low strength.	Moderate: seepage.	Moderate: piping.	Poor: low strength.	Fair: thin layer.	Favorable	Favorable	Not needed.
Severe: low strength.	Moderate: seepage.	Moderate: piping.	Poor: low strength.	Fair: thin layer.	Not needed	Slope	Slope.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Slope	Not needed.
Severe: shrink-swell.	Slight	Moderate: low strength.	Poor: shrink-swell.	Poor: too clayey.	Not needed	Slope	Not needed.
Severe: shrink-swell; wetness.	Slight	Severe: compressible; shrink-swell.	Poor: wetness.	Poor: wetness.	Percs slowly	Wetness	Not needed.

TABLE 8.—*Engineering*

[Tests performed by the Texas Highway Department in accordance with standard

Soil name and location	Parent material	Report no.	Depth	Shrinkage		
				Limit	Lineal	Ratio
			In	*Pct*	*Pct*	
Bernaldo:	Alluvial sediment.	70-48-R	0-7	19	1.8	1.71
3 miles east of Annona on U.S. Highway 82, 2.5 miles south on county road, west side of road in gully. (Modal)		70-49-R	24-37	17	5.6	1.79
		70-50-R	54-66	18	9.3	1.77
Bryarly:	Shaly clay.	70-58-R	28-40	17	22.1	1.91
4.5 miles north of Clarksville on Texas Highway 37, 200 feet east of road in pine plantation. (Modal)		70-59-R	49-83	15	22.5	1.90
Burleson:	Shaly clay.	70-60-R	24-56	14	22.4	1.97
12 miles south of the junction of U.S. Highway 82 and Texas Highway 37 in Clarksville on Texas Highway 37, 1 mile west on county road, 1 mile north on county road, east of road 660 feet and 200 feet east of house. (Modal)						
Wrightsville:	Alluvial: loam, sandy clay loam, and fine sandy loam.	70-54-R	6-15	16	7.3	1.83
25 miles northwest of Clarksville to Kiomatia, 1.25 miles north on Farm Road 410, 0.9 mile west on pasture road. (Modal)		70-55-R	25-46	12	16.5	1.97

[1] Mechanical analyses according to AASHTO Designation: T 88-57 (See footnote 7, p. 82.) Results by this procedure differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

test data

procedures of American Association of State Highway and Transportation Officials (AASHTO)]

Mechanical analysis[1]								Liquid limit	Plasticity index	Classification[2]	
Percentage passing sieve—					Percentage smaller than—						
⅜ in	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm			AASHTO[3]	Unified[4]
								Pct			
			100	46	28	6	2	23	4	A–4	SM-SC
			100	54	40	19	18	28	13	A–6	CL
			100	64	48	29	27	37	23	A–6	CL
			98	96	94	75	66	75	46	A–7–6	CH
99	98	98	97	95	91	70	56	76	45	A–7–6	CH
				97	94	66	57	72	48	A–7–6	CH
			100	78	63	28	22	30	15	A–6	CL
				87	79	47	40	48	33	A–7–6	CL

[2] Classification made by Soil Conservation Service personnel.
[3] Based on AASHTO Designation M 145–49.
[4] Based on the Unified soil classification system (See footnote 6, p. 82).

erties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have different meanings in soil science than in engineering. The Glossary defines many of these terms as they are commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system[6] used by SCS engineers, the Department of Defense, and others, and the AASHTO system[7] adopted by the American Association of State Highway and Transportation Officials.

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and content of organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML-CL.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. Group A–1 consists of gravelly soils that have high bearing strength, the best soils for subgrade (foundation). At the other extreme, group A–7 consists of clay soils that have low strength when wet, the poorest soils for subgrade. If laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils is shown in table 8; the estimated classification, without group index numbers, is given in table 6 for all soils mapped in the county.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are given in table 6. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 6.

Hydrologic soil groups indicate runoff potential. Soils are classified on the basis of intake of water at the end of long-duration storms, occurring after the soil has had prior wetting and opportunity for swelling and when the soil has been without the protection of vegetation. The four major soil groups currently recognized range from group A, which consists of soils having the lowest runoff potential, to group D, which consists of soils having the highest runoff potential.

Soils in group A have a high rate of infiltration when thoroughly wet. These soils are deep and well drained to excessively drained and consist mainly of sand or gravel, or both. They have a high rate of water transmission and a low runoff potential.

Soils in group B have a moderate rate of infiltration when thoroughly wet. These soils are moderately deep to deep, and moderately well drained to well drained. They are moderately fine textured to moderately coarse textured. These soils have a moderate rate of water transmission.

Soils in group C have a slow rate of infiltration when thoroughly wet. These soils have a layer that impedes downward movement of water, or they are moderately fine textured to fine textured. They have a slow rate of water transmission.

Soils in group D have a very slow rate of infiltration when thoroughly wet. These soils have a high shrink-swell potential, have a permanent high water table, have a claypan or clay layer at or near the surface, or are shallow over nearly impervious material. They have a very slow rate of water transmission and a high runoff potential.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table 6 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary at the back of this survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 6, but in table 8 the data on liquid limit and plasticity index are based on tests of soil samples.

[6] UNITED STATES DEPARTMENT OF DEFENSE. Unified Soil Classification System for Roads, Airfields, and Foundations, MIL—STD—619B, 30 pp., illus., 1968.

[7] AMERICAN ASSOCIATION OF HIGHWAY [AND TRANSPORTATION] OFFICIALS. Standard Specifications for Highway Materials and Methods of Sampling and Testing, Ed. 8, 2v., illus., 1961.

Permeability is the quality of a soil that enables it to transmit water or air. It is estimated on the basis of characteristics of the soil observed in the field, particularly structure and texture. The estimates in table 6 do not take into account lateral seepage or such transient soil features as plowpans and surface crusting.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected in soil material with changes in moisture content; that is, the extent to which the soil shrinks as it dries or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures (fig. 17). A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

***Figure 17.*—Sidewalk broken by shrinking and swelling of Houston Black clay, 1 to 3 percent slopes.**

Corrosivity, as used in table 6, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of soil material. Corrosivity to concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Engineering interpretations

The interpretations in table 7 are based on the estimated engineering properties of soils shown in table 6, on test data for soil in this county and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Red River County. In table 7, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than drainage for crops and pasture, waterways, and terraces and diversions. For these particular uses, table 7 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means that soil properties are generally favorable for the rated use, or in other words, that limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated by the terms good, fair, and poor, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 7.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material is evaluated from a depth of 18 inches to a depth of 6 feet. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and has sides or embankments of compacted soil material. The assumptions are made

that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, content of organic matter, and slope, and if the floor needs to be leveled, depth to bedrock is important. The soil properties that affect the embankment are engineering properties of the embankment material as interpreted from the Unified soil classification system and the number of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewerlines, telephone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Dwellings without basements, as rated in table 7, are not more than three stories high, and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the ratings in table 7 apply only to a depth of about 6 feet, and therefore limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper. For some soils, reliable predictions can be made to a depth of 10 or 15 feet, but regardless, every site should be investigated before it is selected.

Local roads and streets, as rated in table 7, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface that is commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material and the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Dikes, levees, and other embankments require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; by natural fertility of the material or the response of plants when fertilizer is applied; and by absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the rating is damage that will result at the area from which topsoil is taken.

Drainage for crops and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence the rate of water movement; depth to the water table; slope and stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Waterways are either natural or shaped channels seeded with grass to carry runoff water in such a way that there is little or no erosion. The suitability of a soil for grassed waterways is determined by the erosion hazard and the amount of shaping that can be done. This depends upon such features as slope, stoniness, and depth to bedrock. The ease of establishing vegetation in the waterway is also an important soil feature.

Terraces and diversions are embankments or ridges constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Soil test data

Table 8 contains engineering test data for some of the major soil series in Red River County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by

tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops.

Shrinkage ratio is the relation of change in volume of the soil material to the water content of the soil material when at the shrinkage limit. The change in volume is expressed as a percentage of the air-dry volume of the soil material, and the water content is expressed as a percentage of the weight of the soil material when ovendry.

Linear shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the given value to the shrinkage limit.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 6.

Formation and Classification of the Soils

This section explains how soils form and discusses the factors that affect the formation of the soils in Red River County. It also discusses the processes by which various soil layers are formed.

Factors of Soil Formation

The factors that determine the kind of soil that formed at any given point are the composition of the parent material in which the soil formed; the climate under which the parent material was deposited and weathered; the plant and animal life living on and in the soil; the relief or lay of the land; and the length of time the forces of soil formation have worked on the soil material.[8]

Parent material

The parent material of most of the soils in the county is acid, unconsolidated, loamy and clayey sediment deposited by water. Annona and Bernaldo soils are examples of soils that formed in these deposits. An area across the center of the county has alkaline or calcareous shale or marl and an area of chalk. Houston Black, Austin, Burleson, and Cuthand soils formed in this material.

Along the Red River, parent material is mainly loamy deposits transported from several hundred miles to the west. On the active flood plain, the soils are stratified a few inches below the surface, indicating deposits from different floods during recent times. This is mostly loamy or sandy sediment. The Kiomatia and Oklared soils formed in these deposits. Deep soils such as Whakana and Wrightsville soils have formed in the loamy and clayey terrace deposits.

Clayey sediment occurs on the flood plain of the Sulphur River and other streams that drain the Blackland Prairie. Kaufman and Gladewater soils formed in these deposits.

Smaller streams that have watersheds consisting mostly of soils that have an acid, loamy surface layer deposited loamy sediment on their flood plains. Nahatche and Thenas soils formed in these deposits.

Climate

The climate of Red River County is warm and humid. Climate features that existed during the time when the soils formed influenced the soil formation.

Temperature, high humidity, and adequate rainfall have encouraged deep penetration of water. Moisture and warm temperature have also favored the development of plant roots, chemical activity, and microorganisms. As a result many deep soils have formed in the county. Calcium and other chemicals have been removed from many of the soils by leaching. This resulted in the formation of soils low in some essential plant nutrients.

Plant and animal life

Vegetation, micro-organisms, earthworms, other organisms, and recently man live on and in the soil and contribute to its development. The kind and amount of vegetation, controlled by climate and parent material, have a great influence on soil formation.

The forest that grows over much of the county contributes organic matter to the top few inches of the soil. This is quickly destroyed when the soils are cultivated, as has happened in the Bernaldo and Elysian soils. Grass, however, favors the accumulation of organic matter to lower depths and contributes to the fertility of the soils. Houston Black clay shows this formation.

Earthworms and worm casts are numerous in the prairie soils of Red River County. They facilitate the movement of air, water, and plant roots in these soils.

Rodents have had an important part in the formation of the sandy and loamy forested soils. They have helped in mixing the parent material in the upper 1 or 2 feet, which makes a homogeneous horizon instead of a mass of stratified parent material. Gophers, for example, are still active in Rosalie soils.

In the past 100 years, the activities of man have considerably affected the soils of the county. He cleared much of the forest and planted crops. This encouraged runoff and erosion and reduced the content of organic matter. Tillage compacted the clayey soils and reduced aeration, infiltration, and permeability. Man also plowed up most of the native prairie with similar results to the soils. All of these changes are reflected in present soil productivity and will be reflected in the future direction and rate of formation of the soils.

Relief

Relief influences soil formation through its influence on drainage, erosion, plant cover, and infiltration. Most of Red River County has low relief and is not severely dissected by streams. As a result, runoff is not rapid, and the soils are moistened to depths of several feet each year. Large, nearly level areas are common, and the Wrightsville and Panola soils, which show characteristics of poor drainage, formed in these areas. Steep soils along streams generally have a thinner surface

[8] BALDWIN, MARK, KELLOGG, CHARLES E., and THORPE, JAMES. Soil Classification. USDA Yearb. 979–1001, illus., 1938.

layer, and if they have been cleared, they are more eroded than nearly level or gently sloping soils.

Some of the effects of relief such as shallow soil formation are not pronounced in Red River County. Abundant rainfall and long warm periods overcome most of its effects, and nearly all soils are deeply formed.

Pimple mounds, a form of microrelief, are common in the county. These turn the intermound areas into tenuous drainageways that have small, slightly depressional spots. Kullit-Addielou complex, 1 to 3 percent slopes, is characteristic of this condition. Cultivation of soils that have mounds is delayed a few days in spring.

Time

The length of time that climate, living organisms, and relief have acted upon the parent material affects the kind of soil that has formed. However, the effects of time are modified by the other four factors of soil formation. Differences in age are apparent in the soil profiles.

Rosalie and Kullit soils formed in older sediment, and they show the development of well-expressed soil horizons, are deep, and are leached in nearly all of the profile. Oklared soils, which formed in recent sediment, show only faint horizonation, higher lime content, and stratification of sediment at a shallow depth.

Processes of Soil Horizon Differentiation

Each soil horizon receives its characteristics from particular soil-forming processes. The A1 horizon is the result of an accumulation of organic matter. As plant litter falls to the ground, it is acted upon by organisms and chemicals that break it down into humus. Humus is mixed with the mineral matter, and the two are converted to soil. Where the vegetation is forest, this horizon is relatively thin because nearly all of the litter is dropped on the surface. Where the vegetation is dominantly grass, decaying plant roots add organic matter at a much lower depth, and the A1 horizon is thicker.

The Ap horizon results from the disturbance of the surface layer by cultivation or grazing. When the A1 horizon is cultivated for several years, organic matter decreases and the layer generally becomes lighter in color. Plant nutrients are removed by crops, and erosion removes some of the layer. The Ap horizon consists only of an altered A horizon (A1, A2), or it consists of a mixture of A and B horizons.

The A2 horizon results from the translocation of lime, clay, iron, or aluminum. As water moves through the horizon, it picks up these materials in solution and carries them to lower horizons. The removal of the minerals makes the horizon lighter in color.

The B2t horizon results when clay leached from the A2 horizon is deposited by water in this part of the profile. Soil structure develops as a result of soil-forming processes.

The C horizon is the result of geologic deposition and consists of unweathered materials. The deposition in most places occurred many years ago, but deposition still occurs on some flood plains.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparision in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.[9]

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 9, the soil series of Red River County are placed in family, subgroup, and order of the current system. The categories of classification of the current system are briefly defined in the following paragraphs.

Orders.—Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables, ending in *sol* (Ent-i-sol).

The six orders to which the soils of Red River county belong are Alfisols, Entisols, Inceptisols, Mollisols, Ultisols, and Vertisols.

Alfisols have a light-colored surface layer low in organic matter, a clay-enriched B horizon, an accumulation of aluminum and iron, and a base saturation of more than 35 percent.

Entisols have little or no evidence of development of pedogenic horizons.

Inceptisols have a light-colored surface layer low in organic matter, but they do not have a clay-enriched B horizon.

Mollisols have a dark-colored surface layer high in organic matter and have a base saturation of more than 50 percent.

[9] UNITED STATES DEPARTMENT OF AGRICULTURE. Soil Classification, A Comprehensive System, 7th Approximation. 265 pp., illus. 1960.

TABLE 9.—*Classification of soil series*

Series	Family	Subgroup	Order
Addielou	Fine-loamy, siliceous, thermic	Typic Paleudults	Ultisols.
Annona	Fine, montmorillonitic, thermic	Vertic Paleudalfs	Alfisols.
Austin	Fine-silty, carbonatic, thermic	Typic Haplustolls (Calciustols)	Mollisols.
Bernaldo	Fine-loamy, siliceous, thermic	Glossic Paleudalfs	Alfisols.
Bryarly	Fine, montmorillonitic, thermic	Vertic Paleudalfs	Alfisols.
Burleson	Fine, montmorillonitic, thermic	Udic Pellusterts	Vertisols.
Crockett	Fine, montmorillonitic, thermic	Udertic Paleustalfs	Alfisols.
Cuthand	Coarse-silty, carbonatic, thermic	Typic Ustochrepts	Inceptisols.
Deport	Fine, montmorillonitic, thermic	Udorthentic Pellusterts	Vertisols.
Desha	Very fine, mixed, thermic	Vertic Hapludolls	Mollisols.
Ellis	Fine, mixed, thermic	Vertic Ustochrepts	Inceptisols.
Elysian	Coarse-loamy, siliceous, thermic	Haplic Glossudalfs	Alfisols.
Ferris	Fine, montmorillonitic, thermic	Udorthentic Chromusterts	Vertisols.
Freestone	Fine-loamy, siliceous, thermic	Glossaquic Paleudalfs	Alfisols.
Gladewater	Fine, montmorillonitic, nonacid, thermic	Vertic Haplaquepts	Inceptisols.
Hapludalfs	Not classified	Not classified	Alfisols.
Houston Black	Fine, montmorillonitic, thermic	Udic Pellusterts	Vertisols.
Kaufman [1]	Fine, montmorillonitic, thermic	Vertic Haplaquolls	Mollisols.
Kenney	Loamy, mixed, thermic, (siliceous)	Grossarenic Paleudalfs	Alfisols.
Kiomatia	Sandy, mixed, thermic	Typic Udifluvents	Entisols.
Kullit	Fine-loamy, siliceous, thermic	Aquic Paleudults	Ultisols.
Mabank	Fine, montmorillonitic, thermic	Vertic Albaqualfs	Alfisols.
McKamie	Fine, mixed, thermic	Vertic Hapludalfs	Alfisols.
Morse	Fine, mixed, thermic	Entic Chromuderts	Vertisols.
Muldrow	Fine, mixed, thermic	Typic Argiaquolls	Mollisols.
Nahatche	Fine-loamy, mixed, nonacid, thermic	Aeric Fluvaquents	Entisols.
Oklared	Coarse-loamy, mixed (calcareous), thermic	Typic Udifluvents	Entisols.
Panola	Fine, montmorillonitic, thermic	Vertic Ochraqualfs	Alfisols.
Redlake	Fine, mixed, thermic	Vertic Eutrochrepts	Inceptisols.
Rodessa	Fine, mixed, thermic	Aquic Glossudalfs	Alfisols.
Roebuck variant	Fine, montmorillonitic, thermic	Vertic Hapludolls	Mollisols.
Rosalie	Loamy, siliceous, thermic	Arenic Paleudults	Ultisols.
Thenas	Coarse-loamy, mixed, thermic	Fluvaquentic Eutrochrepts	Inceptisols.
Trinity	Fine, montmorillonitic (calcareous), thermic	Vertic Haplaquolls	Mollisols.
Varro	Fine-loamy, mixed (calcareous), thermic	Typic Udifluvents	Entisols.
Vesey	Fine-loamy, mixed, thermic	Glossic Paleudalfs	Alfisols.
Waskom	Fine-loamy, mixed, thermic	Aquic Argiudolls	Mollisols.
Whakana	Fine-loamy, mixed, thermic	Glossic Paleudalfs	Alfisols.
Woodtell	Fine, montmorillonitic, thermic	Vertic Hapludalfs	Alfisols.
Wrightsville	Fine, mixed, thermic	Typic Glossaqualfs	Alfisols.

[1] These soils are taxadjunct to the Kaufman series in that their dark A horizon is slightly thinner than is typical for the series. The use, management, and behavior of these soils are similar to those of soils in the Kaufman series.

Ultisols have a light-colored surface layer low in organic matter, a clay-enriched B horizon, and a base saturation of less than 35 percent.

Vertisols are clayey soils that have deep, wide cracks part of the year in most years.

Suborders.—Each order is subdivided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquent* (*Aqu,* meaning water or wet, and *ent,* from Entisol).

Great groups.—Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark red and dark brown associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquolls (*Hapl,* meaning simple horizons, *aqu* for wetness or water, and *oll,* from Mollisols).

Subgroups.—Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Vertic Haplaquolls (a Haplaquoll that has a large amount of expansive clay).

Families.—Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the basis of the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on that are used to differentiate among families. An example is the fine, montmorillonitic, thermic family of Vertic Haplaquolls.

Environmental Factors Affecting Use of the Soils

In this section the environmental factors that affect the use of the soils in the county are discussed. These factors are climate, geology, relief and drainage, farming, transportation and markets, and water supply.

Climate [10]

The climate of Red River County is humid subtropical and is characterized by warm summers. Rainfall averages 45.61 inches annually and is evenly distributed throughout the year. Table 10 gives a summary of temperature and precipitation data for Clarksville. Prevailing winds are southerly from March through September and northeasterly from October through February. Thus, the Gulf of Mexico plays a dominant role in the climate of the area in spring and summer, and modified polar airmasses contribute significantly to the climate in fall and winter.

[10] By ROBERT B. ORTON, climatologist for Texas, National Weather Service, U.S. Department of Commerce.

Winter temperatures are mild, and there are only about 3 days each year when the daily maximum fails to go above freezing. Infrequent arctic airmasses, moving southward out of Canada, bring sharp drops in temperature. These cold spells are usually of short duration. Typically, the weather turns cold one day, reaches the lowest temperature on the second night, and then warms up again on the third day. Cloudiness is more prevalent in winter, but the area continues to receive about 50 percent of the total possible sunshine during this season. Winds accompanying a vigorous cold front may be strong and northerly, but they decrease rapidly soon after its passage.

Summer temperatures are usually not excessive, but light or very light winds during the late afternoon and night cause high temperatures to be more oppressive than they would be at higher windspeeds. Air conditioning is recommended for maximum comfort indoors.

The spring and fall are delightful seasons of the year. The days are warm, and the nights are cool.

Thundershowers are frequent from May through September. Peak rainfall occurs in April and May; August is the driest month. The greatest total annual rainfall in Texas weather history, 109.38 inches, was recorded at Clarksville in 1873. The least annual rainfall recorded at Clarksville was 21.12 inches in 1936. The greatest 24-hour rainfall recorded at Clarksville was 8.30 inches on May 22, 1933.

Snowfall is insignificant as a source of moisture at Clarksville; only one measurable snow has fallen during the 12-year period of 1955–66. Average snowfall data are biased by rare, exceptionally heavy snows, such as the 12.0 inches total received in March 1942.

The growing season (freeze-free period) at Clarksville averages 225 days. The average date of the last freeze in spring is March 25, and the average date of the first freeze in fall is November 5.

TABLE 10.—*Temperature*

[Data from weather bureau

Month	Temperature				Average total		
	Average daily maximum	Average monthly maximum	Average daily minimum	Average monthly minimum		0 or trace	0.50 inch or more
	°F	°F	°F	°F			
January	54.2	74.6	32.6	13.0	3.20	(2)	95
February	58.7	76.1	36.3	20.3	3.47	1	98
March	65.5	81.6	42.0	25.0	4.34	1	(2)
April	75.4	86.6	52.3	35.9	5.65	1	99
May	82.3	90.6	60.5	47.3	5.19	1	99
June	89.5	96.4	68.0	58.8	3.55	3	94
July	93.8	100.3	70.9	63.9	3.33	1	90
August	94.2	102.0	70.1	62.0	2.98	1	87
September	87.7	97.4	63.3	48.7	3.25	1	90
October	78.8	89.5	52.8	36.0	3.24	1	95
November	65.4	80.9	41.4	24.6	3.97	1	90
December	56.2	74.4	34.5	18.3	3.34	1	97
Year	75.4		52.1		45.61		

[1] Data are mainly for the period 1937–66.

[2] Less than 1 percent.

Average annual relative humidity is 85 percent at 6:00 a.m. and 55 to 60 percent at noon and at 6:00 p.m. The area receives about 68 percent of the total possible sunshine annually. Mean annual lake evaporation is between 50 and 52 inches. Average hourly windspeeds are among the lowest in Texas, annually averaging about 8 miles per hour.

Severe local storms occur infrequently in the Clarksville area. Only eight tornadoes are known to have touched ground in Red River County during the period 1896–1966. Two of these occurred in 1961.

Geology

The geologic strata in which the soils of the county developed consist mostly of clay, marl, shale, and sand deposited during Cretaceous, Eocene, Pleistocene, and Recent times.[11]

Surface exposures of Cretaceous System rocks predominate in the county. Exceptions include alluvium (Recent Series) and terrace deposits (Pleistocene Series) along the Red River and the Sulphur River and their tributaries. Erosional remnants of terrace deposits are present near Avery. An outcrop of the Midway Group (Eocene Series) occurs in the extreme southeastern part of the county.

Immediately before the Cretaceous Period, continental North America was practically all dryland. Upon this dryland Cretaceous seas encroached, covered the land, and left their record in the form of many deposits. The Cretaceous Period marked the last great epicontinental marine invasion of North America.[12]

Strata of the Cretaceous System are represented by the Woodbine Group, Eagle Ford Formation, Austin Group, Taylor Group, and Navarro Group in the county.

The rocks of the Woodbine Group (undivided) are the oldest surface exposures and are largely made up of ferruginous, argillaceous sand, characterized by intense discoloration in places, and lesser occurrences of sandy laminated clay. Soils such as Kullit and Bernaldo are dominant, but there are small areas of Woodtell soils.

The Woodbine Group is overlain by the Eagle Ford Formation and consists chiefly of dark-gray to nearly black shale that is commonly gypsiferous and bituminous. In places, crystals of selenite weather from the shale in great numbers. Woodtell and Kullit are typical soils.

The Austin Group overlies the Eagle Ford Formation and underlies the Taylor Group. The Austin is represented by the Bonham Formation and the Blossom Sand Formation. The Bonham consists of a greenish-gray, waxy marl and clay. The Blossom Sand is a calcareous quartz sand with thin clay interbeds. Soils such as Wrightsville, Woodtell, and Annona are dominant in this area.

The Taylor Group is represented, in ascending order, by the Brownstown Marl, Ozan, Annona Chalk, Pecan Gap Chalk, and Marlbrook Marl Formations. The Brownstown Marl is composed of dark-gray marl and clay that are, in part, sandy. The Ozan Formation is a bluish-gray, calcareous clay and has some fine sand. The Annona Chalk consists of a thickly bedded to massive, hard chalk that is, in part, argillaceous and sandy. The Pecan Gap Chalk is a slightly bituminous chalk that is, in part, argillaceous and sandy. The Marlbrook Marl is composed of a strikingly uniform marl that is highly plastic when wet. This formation forms a smooth, rolling topography. The dominant soils on the clayey members of this group are Burleson, Ferris, Houston Black, Deport, and Ellis. The more chalky members give rise to Austin and Cuthand soils.

[11] UNIVERSITY OF TEXAS. Geologic Atlas of Texas, Texarkana, Sheet Map With Text, 1966.

[12] SELLARDS, E. M., ADKINS, W. S., and PLUMMER, F. B. The Geology of Texas. v. 1, Stratigraphy. University of Texas, Bull. 3232. 1007 pp., illus. 1932.

and precipitation data [1]

station at Clarksville]

Precipitation								
Probability, in percent, of receiving selected amounts during month						Average number of days with—		
1.00 inch or more	2.00 inches or more	3.00 inches or more	4.00 inches or more	5.00 inches or more	6.00 inches or more	0.10 inch or more	0.50 inch or more	1.00 inch or more
90	70	50	36	25	10	5	2	1
92	73	52	38	25	15	7	2	1
96	82	60	45	26	17	7	3	1
97	90	74	60	44	34	8	3	2
98	90	75	60	46	31	6	3	2
90	71	52	40	30	20	6	3	2
80	60	47	34	25	15	5	2	1
77	51	38	25	15	10	4	2	1
80	60	40	30	20	12	4	3	2
95	60	41	25	20	10	4	2	1
80	65	48	38	30	23	4	2	1
92	73	55	40	28	20	5	2	1
						65	29	16

[1] Greater than 99 percent.

The Navarro Group (undivided) consists of fine-grained, indistinctly to thinly bedded, silty, clayey sand in the lower part. The upper part is composed mainly of silty, sandy clay. The sand increases lower in the section. A distinctive characteristic of the group is the common occurrence of calcareous concretions. Soils such as Annona, Panola, Wrightsville, and Woodtell are dominant in this group.

The Midway Group (undivided) is calcareous, silty, sandy clay in the lower part and has some thin beds of limestone. The upper part is mainly silty clay that is locally lignitic and contains some concretions of calcareous siltstone. Soils such as Crockett, Woodtell, and Panola are dominant in this group.

Five Pleistocene Series terraces are mapped in the county, and they range in elevation from approximately 3 feet to 160 feet above the flood plain. Materials include sand, silt, and clay. The largest areas of soils that formed in terrace deposits occur parallel to the Red River. Soils such as McKamie, Vesey, and Whakana are common, but Wrightsville soils are dominant.

Recent Series deposits occur on the flood plains of the Red River on the northern boundary of the county, the Sulphur River on the southern boundary and the tributaries of these rivers. Oklared and Kiomatia are examples of soils that formed in the alluvium of the Red River. Soils of the Kaufman, Gladewater, and Trinity series are dominant on the flood plains of the Sulphur River and streams that drain the Blackland Prairie. Nahatche and Thenas soils formed in alluvium of the smaller streams. The drainage areas of these soils are composed mainly of forested soils.

Relief and Drainage

Red River County is on the divide between the Red River and the Sulphur River. It slopes generally to the east and is characterized by low relief. Elevation ranges from about 250 feet in the southeastern part to about 500 feet in the western part. About 83 percent of the soils have slopes of less than 3 percent. The area of greatest relief occurs in the northern part of the county at the junction of the flood plain of the Red River and its high terraces or on the upland. The descent from the upland to the flood plain of the Sulphur River is more gradual.

The upland is characterized by gently sloping ridges that have short, strongly sloping or moderately steep, convex side slopes leading to streams.

The Red River flows southeast across the north edge of the county. Pecan Bayou and Little Pine Creek are its major tributaries. The Sulphur River flows east across the south edge of the county and drains slightly more than 50 percent of it. Cuthand Creek is its major tributary.

Overall drainage conditions in the county are good for cultivated crops, pasture, and woodland. However, about 20 percent of the soils on the upland and terraces are poorly drained, which limits production. Soils on the Sulphur River flood plain are somewhat poorly drained to poorly drained. The major soil on the Red River flood plain is somewhat poorly drained, and most of the soils on the flood plain of the smaller streams of the county are moderately well drained to somewhat poorly drained.

Farming

The early settlers in Red River County discovered a land of forest and open prairie. Tall grasses, such as big bluestem and indiangrass, covered the prairie. Oak, sweetgum, cottonwood, sycamore, elm, hickory, and pine trees grew profusely across the southern and northern parts of the county. The sandier wooded land was the first land to be cultivated, and the prairie was cultivated in the 1840's.

The acreage of cultivated crops, such as cotton and corn, increased until 1925, when 149,300 acres of cotton was grown. Since then, lower fertility, insects, and low prices for farm products have forced a gradual decrease in the acreage of cropland. There is now about 73,000 acres of cropland in the county. The decrease in the acreage of cropland has been accompanied by an increase in the acreage of pastureland. About 284,000 acres is used for pastureland.

About 305,000 acres of the county is wooded. Most of this consists of relatively unproductive hardwoods of low value. About 173,000 acres needs reestablishment and reinforcement of desirable species, and about 72,000 acres needs improvement of timber stands.

At one time there were over 4,000 farms in Red River County, but now there are only about 2,000.

Transportation and Markets

Red River County is adequately served by highways and railroads. The Texas and Pacific Railroad (east-west) crosses at about the middle of the county, U. S. Highway No. 82 (east-west) crosses the middle of the county, Texas Highway No. 37 (north-south) crosses the county, and U. S. Highway No. 281 crosses the southwestern corner of the county.

Nearly all parts of the county are accessible by a good network of farm-to-market roads. These roads connect rural communities to each other and to the towns in the county.

The principal market in the county is the livestock auction held weekly in Clarksville. In addition, a local market exists in the northwestern part of the county for cucumbers, and a tomato market is located in Avery. These markets are adequate for the limited acreage of both crops.

The metropolitan markets nearby are Texarkana, about 60 miles to the east of Clarksville, and Dallas-Ft. Worth, about 140 miles southwest of Clarksville. The railroad or highway furnishes easy access to Texarkana, but the Dallas-Ft. Worth area is more easily reached by highway.

Water Supply

The water supply of the county is barely adequate to meet all the needs. Clarksville and Bogata get municipal water from wells. Clarksville also has water rights from Site 1, Langford Creek Watershed, to meet future needs. Other towns get their water from water supply corporations.

All but the very thinly populated areas of the county are served by rural water supply corporations. The thinly populated sections of the wooded part of the county ordinarily get enough water for home use from wells. Most parts of the prairie section of the county not served by water supply corporations depend on cisterns for household water.

Nearly all water for livestock is secured from constructed ponds or lakes. Satisfactory sites for stock ponds can be found on most farms. However, in places the high terraces in the north part of the county have permeable layers in the substratum at depths that are too shallow for satisfactory ponds.

Site 1, Langford Creek Watershed, is being developed for recreation by Clarksville. Ten other watershed lakes and numerous other lakes greater than 5 acres in size can be developed for recreation and wildlife.

Only the Red River is a permanent stream. Other large streams such as the Sulphur River, Cuthand Creek, and Pecan Bayou have only pools of water late in summer and in fall.

Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment does not change.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Deferred grazing. The practice of delaying grazing until range plants have reached a definite stage of growth, in order to increase the vigor of the forage and to allow the desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain, also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension: *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For

example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil series or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil series, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisure content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.5 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Site index. A numerical means of expressing the quality of a forest site that is based on the height of the dominant stand at an arbitrarily chosen age; for example, the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

☆U.S. GOVERNMENT PRINTING OFFICE: 1977-225-471/28

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or other land use interpretative group, read the introduction to the section it is in for general information about its management. Dashes indicate that the soil was not placed in a particular grouping. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Predicted yields, table 2, page 44.
Suitability of soils for woodland, table 3, page 50.
Suitability of soils for elements of wildlife habitat and for kinds of wildlife, table 4, page 63.
Degree of limitation and major factors affecting recreational uses, table 5, page 66.
Use of soils in engineering, tables 6, 7, and 8, pages 68 through 81.

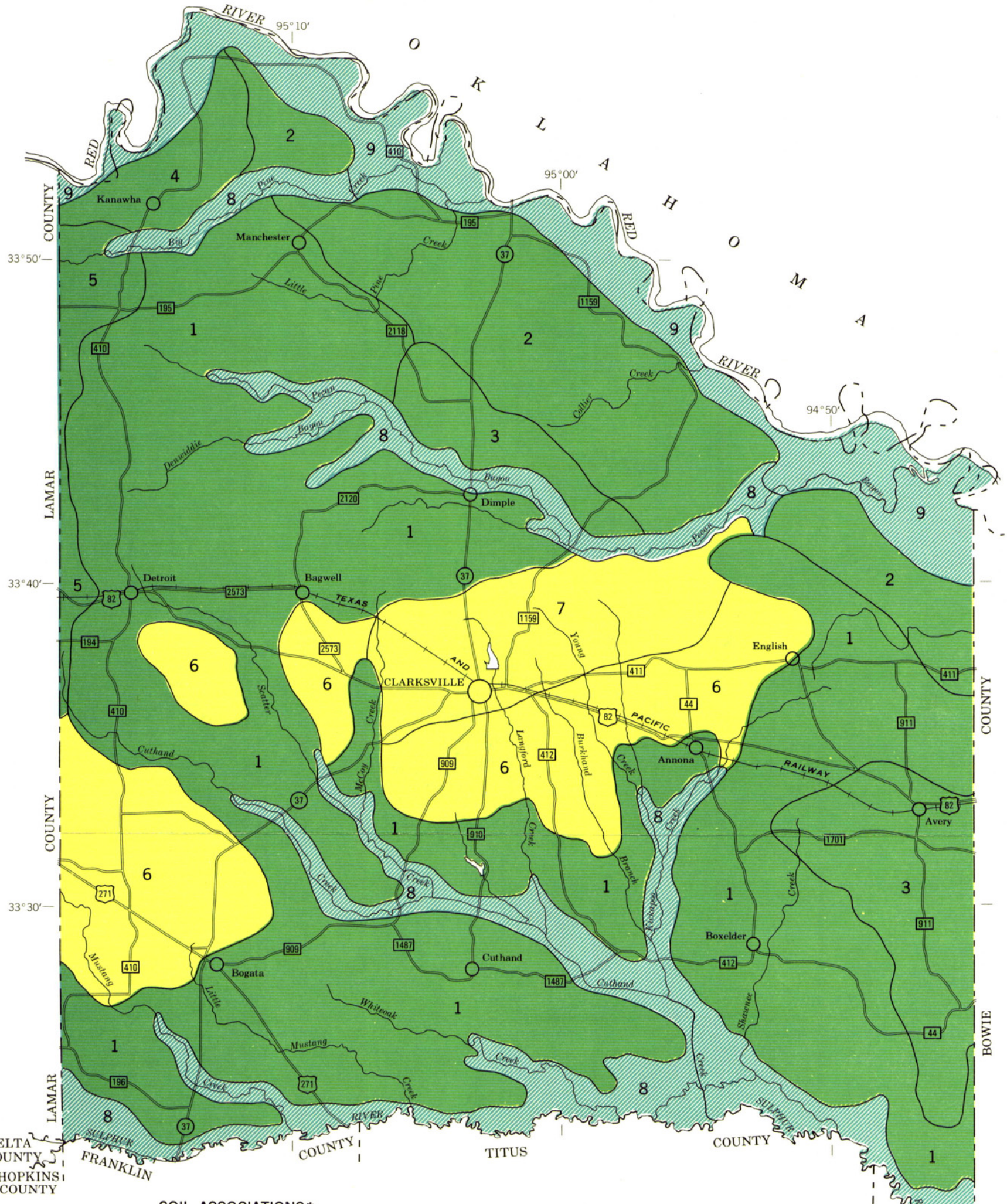
Map symbol	Mapping unit	Page	Capability unit		Pasture and hayland group		Woodland suitability group		Woodland grazing group
			Symbol	Page	Symbol	Page	Symbol	Page	Name
AfB	Annona-Freestone complex, 1 to 3 percent slopes	8	IIIe-1	41	--	--	---	--	----------
	Annona part	--	------	--	8A	48	4c2	60	Tight Sandy Loam
	Freestone part	--	------	--	8C	48	3w8	60	Sandy Loam
AuB	Austin silty clay, 1 to 3 percent slopes	9	IIIe-3	41	7C	48	---	--	----------
BeB	Bernaldo-Elysian complex, 1 to 3 percent slopes	10	IIe-1	40	8C	48	2o7	58	Sandy Loam
BrC	Bryarly clay loam, 1 to 5 percent slopes	11	IVe-1	42	8A	48	5c2	60	Tight Sandy Loam
BuA	Burleson clay, 0 to 1 percent slopes	11	IIw-3	41	7A	47	---	--	----------
BuB	Burleson clay, 1 to 3 percent slopes	12	IIe-3	40	7A	47	---	--	----------
CrB	Crockett loam, 1 to 3 percent slopes	12	IIIe-1	41	8A	48	---	--	----------
CuD2	Cuthand loam, 4 to 8 percent slopes, eroded	13	VIe-2	43	7D	48	---	--	----------
DaB	Deport clay, 1 to 3 percent slopes	14	IIIe-5	41	7A	47	---	--	----------
DeA	Desha clay, 0 to 1 percent slopes	14	IIIw-2	42	1A	47	2w6	59	Clayey Bottomland
DeB	Desha clay, 1 to 3 percent slopes	14	IIIw-2	42	1A	47	2w6	59	Clayey Bottomland
EsC	Ellis clay, 3 to 5 percent slopes	15	IVe-1	42	7A	47	---	--	----------
FeD2	Ferris clay, 3 to 8 percent slopes, eroded	16	VIe-2	43	7B	48	---	--	----------
FrA	Freestone-Addielou complex, 0 to 1 percent slopes	17	IIw-2	41	8C	48	---	--	Sandy Loam
	Freestone part	--	------	--	--	--	3w8	60	----------
	Addielou part	--	------	--	--	--	3o7	59	----------
Gd	Gladewater clay	18	IIIw-2	42	1B	47	2w6	59	Clayey Bottomland
Gf	Gladewater clay, frequently flooded	18	Vw-3	42	1B	47	2w6	59	Clayey Bottomland
HaB	Hapludalfs, loamy, 0 to 2 percent slopes	19	I-1	40	2A	47	2o4	58	Loamy Bottomland
HoB	Houston Black clay, 1 to 3 percent slopes	19	IIe-2	40	7A	47	---	--	----------
Ka	Kaufman clay	20	IIw-1	40	1A	47	1w6	58	Clayey Bottomland
Kb	Kaufman clay, frequently flooded	20	Vw-3	42	1A	47	1w6	58	Clayey Bottomland
KeD	Kenney loamy fine sand, 2 to 8 percent slopes	21	IIIe-4	41	9B	49	3s2	60	Sandy
Ko	Kiomatia loamy fine sand, frequently flooded	21	Vw-2	42	3A	47	2w5	58	Sandy Bottomland
KuB	Kullit-Addielou complex, 1 to 3 percent slopes	22	IIe-1	40	8C	48	---	--	Sandy Loam
	Kullit part	--	------	--	--	--	2w8	59	----------
	Addielou part	--	------	--	--	--	3o7	59	----------
MaA	Mabank fine sandy loam, 0 to 1 percent slopes	23	IIIw-1	42	8A	48	---	--	----------
McC	McKamie loam, 1 to 5 percent slopes	24	IVe-1	42	8A	48	3c2	60	Tight Sandy Loam
McE	McKamie loam, 5 to 12 percent slopes	24	VIe-1	43	8B	48	3c2	60	Tight Sandy Loam
MoD2	Morse clay, 3 to 8 percent slopes, eroded	25	VIe-2	43	7B	48	---	--	----------

Map symbol	Mapping unit	Page	Capability unit		Pasture and hayland group		Woodland suitability group		Woodland grazing group
			Symbol	Page	Symbol	Page	Symbol	Page	Name
Mu	Muldrow silty clay loam	25	IIw-2	41	1A	47	2w5	58	Clayey Bottomland
Mx	Muldrow-Elysian complex	25	IIw-2	41	--	--	---	--	----------
	Muldrow part	--	------	--	1A	47	2w5	58	Clayey Bottomland
	Elysian part	--	------	--	8C	48	2o7	58	Sandy Loam
Na	Nahatche soils, frequently flooded	26	Vw-1	42	2C	47	1w6	58	Loamy Bottomland
Of	Oklared fine sandy loam	27	IIw-4	41	2A	47	2o4	58	Loamy Bottomland
Ok	Oklared silty clay loam	27	IIw-4	41	2A	47	2o4	58	Loamy Bottomland
Pa	Panola silty clay	27	IVw-1	42	8E	48	---	--	Flatwoods
Rc	Redlake clay	28	IIIw-2	42	1A	47	3w6	60	Clayey Bottomland
Rd	Redlake soils	28	IIIw-3	42	2A	47	3w6	60	Loamy Bottomland
Rf	Roebuck clay, calcareous variant	29	IIIw-2	42	1A	47	2w6	59	Clayey Bottomland
RsC	Rosalie loamy fine sand, 2 to 5 percent slopes	30	IIIs-1	42	9A	48	3s2	60	Sandy
Th	Thenas fine sandy loam, frequently flooded	30	Vw-1	42	2A	47	1w8	58	Loamy Bottomland
Tr	Trinity clay	31	IIw-1	40	1A	47	1w6	58	Clayey Bottomland
Ts	Trinity clay, frequently flooded	32	Vw-3	42	1A	47	1w6	58	Clayey Bottomland
Va	Varro clay loam	32	Vw-1	42	2A	47	1w5	58	Loamy Bottomland
VeD	Vesey fine sandy loam, 3 to 8 percent slopes	33	IIIe-2	41	8C	48	3o1	59	Sandy Loam
VeF	Vesey fine sandy loam, 8 to 20 percent slopes	33	VIe-3	43	8D	48	3o1	59	Sandy Loam
Wa	Waskom loam	34	IIw-2	41	2A	47	2w5	58	Loamy Bottomland
WhD	Whakana loam, 3 to 8 percent slopes	35	IIIe-2	41	8C	48	2o7	58	Sandy Loam
WkA	Whakana-Elysian complex, 0 to 1 percent slopes	35	I-1	40	8C	48	2o7	58	Sandy Loam
WoC	Woodtell fine sandy loam, 1 to 5 percent slopes	37	IIIe-1	41	8A	48	4c2	60	Tight Sandy Loam
WoE	Woodtell fine sandy loam, 5 to 12 percent slopes	37	VIe-1	43	8B	48	4c2	60	Tight Sandy Loam
Wr	Wrightsville-Rodessa complex	38	IVw-1	42	--	--	---	--	----------
	Wrightsville part	--	------	--	8E	48	3w9	60	Flatwoods
	Rodessa part	--	------	--	8C	48	3w8	60	Sandy Loam

NRCS Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.



SOIL ASSOCIATIONS*

NEARLY LEVEL TO MODERATELY STEEP FORESTED SOILS OF TERRACES AND UPLANDS

1 WOODTELL-WRIGHTSVILLE-ANNONA association: Moderately well drained to poorly drained, very slowly permeable, loamy soils

2 WRIGHTSVILLE-McKAMIE association: Poorly drained and well drained, very slowly permeable, loamy soils

3 KULLIT-BERNALDO association: Moderately well drained and well drained, moderately slowly permeable and moderately permeable, loamy soils

4 WHAKANA-VESEY association: Well-drained, moderately permeable, loamy soils

5 WOODTELL-KULLIT association: Moderately well drained, very slowly permeable and moderately slowly permeable, loamy soils

NEARLY LEVEL AND GENTLY SLOPING PRAIRIE SOILS OF UPLANDS

6 BURLESON-DEPORT association: Moderately well drained and somewhat poorly drained, very slowly permeable, clayey soils

7 HOUSTON BLACK-AUSTIN association: Moderately well drained and well drained, very slowly permeable and moderately slowly permeable, clayey soils

NEARLY LEVEL AND GENTLY SLOPING FORESTED SOILS OF BOTTOM LANDS

8 KAUFMAN-GLADEWATER association: Somewhat poorly drained and poorly drained, very slowly permeable, clayey soils

9 OKLARED-DESHA association: Well drained and somewhat poorly drained, moderately rapidly permeable and very slowly permeable, loamy and clayey soils

*Texture given in descriptive title refers to texture of the surface layer.

Compiled 1974

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

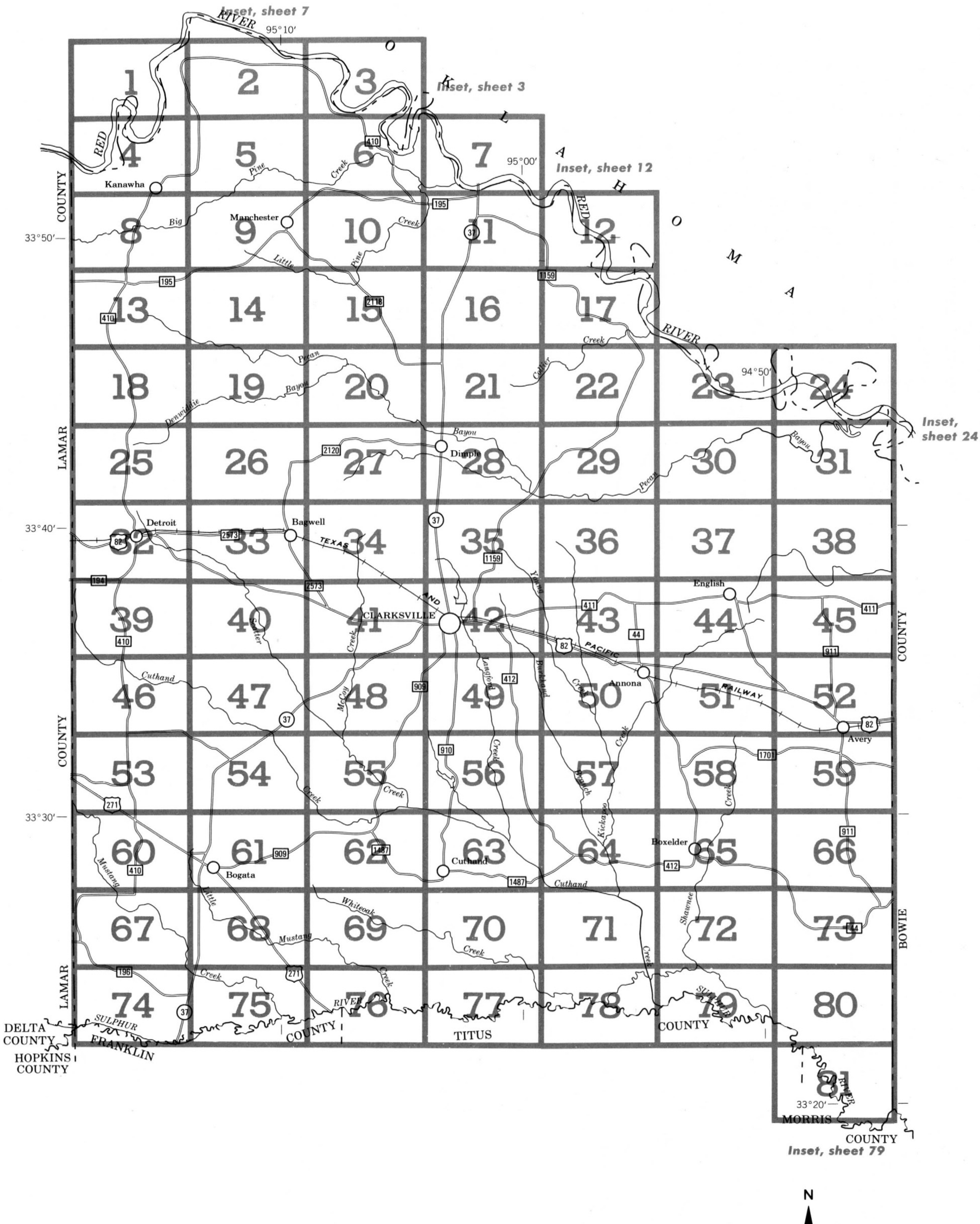
N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
RED RIVER COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles



INDEX TO MAP SHEETS

RED RIVER COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

SOIL LEGEND

The first letter, always a capital, is the initial letter of the soil name. The second letter is a capital if the mapping unit is broadly defined 1/; otherwise, it is a small letter. The third letter, always a capital, shows the slope. Symbols without slope letters are those of nearly level soils. A final number, 2, in the symbol shows that the soil has been eroded.

SYMBOL	NAME
AfB	Annona-Freestone complex, 1 to 3 percent slopes
AuB	Austin silty clay, 1 to 3 percent slopes
BeB	Bernaldo-Elysian complex, 1 to 3 percent slopes
BrC	Bryarly clay loam, 1 to 5 percent slopes
BuA	Burleson clay, 0 to 1 percent slopes
BuB	Burleson clay, 1 to 3 percent slopes
CrB	Crockett loam, 1 to 3 percent slopes
CuD2	Cuthand loam, 4 to 8 percent slopes, eroded
DaB	Deport clay, 1 to 3 percent slopes
DeA	Desha clay, 0 to1 percent slopes
DeB	Desha clay, 1 to 3 percent slopes
EsC	Ellis clay, 3 to 5 percent slopes
FeD2	Ferris clay, 3 to 8 percent slopes, eroded
FrA	Freestone-Addielou complex, 0 to 1 percent slopes
Gd	Gladewater clay
Gf	Gladewater clay, frequently flooded
HaB	Hapludalfs, loamy, 0 to 2 percent slopes
HoB	Houston Black clay, 1 to 3 percent slopes
Ka	Kaufman clay
Kb	Kaufman clay, frequently flooded
KeD	Kenney loamy fine sand, 2 to 8 percent slopes
Ko	Kiomatia loamy fine sand, frequently flooded
KuB	Kullit-Addielou complex, 1 to 3 percent slopes
MaA	Mabank fine sandy loam, 0 to 1 percent slopes
McC	McKamie loam, 1 to 5 percent slopes
McE	McKamie loam, 5 to 12 percent slopes
MoD2	Morse clay, 3 to 8 percent slopes, eroded
Mu	Muldrow silty clay loam
Mx	Muldrow-Elysian complex
Na	Nahatche soils, frequently flooded
Of	Oklared fine sandy loam
Ok	Oklared silty clay loam
Pa	Panola silty clay
Rc	Redlake clay
Rd	Redlake soils
Rf	Roebuck clay, calcareous variant
RsC	Rosalie loamy fine sand, 2 to 5 percent slopes
Th	Thenas fine sandy loam, frequently flooded
Tr	Trinity clay
Ts	Trinity clay, frequently flooded
Va	Varro clay loam
VeD	Vesey fine sandy loam, 3 to 8 percent slopes
VeF	Vesey fine sandy loam, 8 to 20 percent slopes
Wa	Waskom loam
WhD	Whakana loam, 3 to 8 percent slopes
WkA	Whakana-Elysian complex, 0 to 1 percent slopes
WoC	Woodtell fine sandy loam, 1 to 5 percent slopes
WoE	Woodtell fine sandy loam, 5 to 12 percent slopes
Wr	Wrightsville-Rodessa complex

1/The composition of these units is more variable than that of others in the survey area but has been controlled well enough to be interpreted for the expected use of the soils.

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State, farm or ranch

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry (QU)

Gravel pit (G.P.)

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Unclassified

Canals and ditches

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Maximum flood pool line

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

RED RIVER COUNTY, TEXAS NO. 1

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

RED RIVER COUNTY, TEXAS — SHEET NUMBER 1

2 665 000 FEET

835 000 FEET

(Joins ins, sh 7)

(Joins sheet 2)

825 000 FEET

2 685 000 FEET

(Joins sheet 4)

RED RIVER

CHOCTAW COUNTY INDEFINITE BOUNDARY OKLAHOMA

OKLAHOMA INDEFINITE BOUNDARY

Wright Lake

Mud Lake

Everidge Lake Cut-Off

RED RIVER

410

Of
HaB
Ko
Wa
Mu
Rf
Ok
Rc
McE
VeD
AfB
Rd
Wr

1

N

1 Mile
5 000 Feet

Scale 1:20000

RED RIVER COUNTY, TEXAS — SHEET NUMBER 2

(2)

N

(Joins inset, sheet 7)

2 710 000 FEET

835 000 FEET

825 000 FEET

2 690 000 FEET

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 5)

Scale 1:20000

1 Mile 5000 Feet

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

RED RIVER

OKLAHOMA BOUNDARY

McCURTAIN CO OKLA

CHOCTAW COUNTY INDEFINITE

Ford Creek

Bartonville Church

Bartonville

Salt Well Slough

Mill Creek

Ford

410

Of Rd Rf HaB Wa Mu DeA DeB Ok WkA AfB Wr McC KuB VeF WhD Th VeD BeB Mx McE

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 2

RED RIVER COUNTY, TEXAS NO. 3

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 715 000 FEET

835 000 FEET

RED RIVER

INDEFINITE BOUNDARY

McCURTAIN COUNTY OKLAHOMA

(Joins sheet 2)

(Joins sheet 6)

Davenport

Salt Well Slough

410

Wa Of Ok Ko Rf Mu DeA WkA Rd

2 738 000 FEET

828 000 FEET

(Joins lower right)

McCURTAIN COUNTY OKLAHOMA INDEFINITE BOUNDARY

RED RIVER

Ko

(Joins sheet 7)

2 741 000 FEET

823 000 FEET

3000 AND 5000-FOOT GRID TICKS

RED RIVER

McCURTAIN COUNTY OKLAHOMA

INDEFINITE BOUNDARY

State Boundary Reference Monument

Of Ok Ko

(Joins inset)

825 000 FEET

2 735 000 FEET

3

N

1 Mile

5000 Feet

Scale 1:20000

RED RIVER COUNTY, TEXAS — SHEET NUMBER 4

(4)

N

1 Mile

5000 Feet

0 0

Scale 1:20000

¼ 1000

½ 2000

¾ 3000

1 4000

5000

(Joins sheet 1)

2 685 000 FEET

820 000 FEET

RED RIVER

CHOCTAW COUNTY

OKLAHOMA

INDEFINITE BOUNDARY

LAMAR COUNTY

INDEFINITE BOUNDARY

CHOCTAW COUNTY

OKLAHOMA

INDEFINITE

PINE CREEK

Ford Creek

Kanawha

410

805 000 FEET

2 665 000 FEET

(Joins sheet 5)

(Joins sheet 8)

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 4

RED RIVER COUNTY, TEXAS — SHEET NUMBER 5

RED RIVER COUNTY, TEXAS NO. 5

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

2 690 000 FEET

820 000 FEET

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 6)

(Joins sheet 9)

2 710 000 FEET

810 000 FEET

Kiomatia

Creek

Pond

Flag Pond

Pine Creek

Big

410

5

N

1 Mile

5000 Feet

Scale · 1:20000

RED RIVER COUNTY, TEXAS — SHEET NUMBER 6

(Joins sheet 3)

N

Scale 1:20000

1 Mile — ¾ — ½ — ¼ — 0

5000 Feet — 4000 — 3000 — 2000 — 1000 — 0

(Joins sheet 5)

(Joins sheet 7)

(Joins sheet 10)

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

RED RIVER COUNTY, TEXAS NO. 7

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(Joins ins, sh 3)

2 740 000 FEET

2 690 000 FEET

843 000 FEET

820 000 FEET

810 000 FEET

838 000 FEET

2 705 000 FEET

2 760 000 FEET

(Joins sheet 6)

(Joins sheet 1) | (Joins sheet 2)

(Joins sheet 11)

INDEFINITE BOUNDARY

RED RIVER

CHOCTAW COUNTY OKLAHOMA

McCURTAIN COUNTY OKLAHOMA

OKLAHOMA INDEFINITE

McCURTAIN COUNTY INDEFINITE

BOUNDARY

Big Pine Creek

Ko, Of, Rf, Ok, Rd, HaB, Wa, Mu, DeA, Rc, DeB, AfB, MeC, McC, WkA, Wr, KuB

37

1 Mile

5000 Feet

Scale 1:20000

RED RIVER COUNTY, TEXAS — SHEET NUMBER 8

(8)

N

(Joins sheet 4)

2 685 000 FEET

805 000 FEET

(Joins sheet 9)

1 Mile

5000 Feet

0 0

Scale 1:20000

1 000 2000 3000 4000 5000

¼ ½ ¾ 1

LAMAR COUNTY BOUNDARY INDEFINITE

790 000 FEET

2 665 000 FEET

(Joins sheet 13)

Pine Hill Church

Pine Creek

Little Pine Creek

Tanyard Creek

410

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 8

RED RIVER COUNTY, TEXAS — SHEET NUMBER 9

RED RIVER COUNTY, TEXAS NO. 9

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 690 000 FEET

805 000 FEET

(Joins sheet 5)

(Joins sheet 8)

(Joins sheet 10)

(Joins sheet 14)

2 710 000 FEET

790 000 FEET

Manchester

MANCHESTER CEMETERY

Addielou

Leesville Church

Big Pine Creek

Little Pine Creek

9

N

Scale 1:20000

1 Mile

5000 Feet

RED RIVER COUNTY, TEXAS — SHEET NUMBER 10

(10)

N

1 Mile

5000 Feet

Scale · 1 : 20000

0 0 1000 2000 3000 4000 5000

(Joins sheet 9)

(Joins sheet 6)

2 735 000 FEET

805 000 FEET

790 000 FEET

2 715 000 FEET

(Joins sheet 15)

(Joins sheet 11)

Wr KuB AfB Th McC WkA Na BeB RsC Pa VeD WoE Gf WhD DeA McE FrA VeF

195 410 2118

Red River

Little Pine Creek Lick Creek

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 10

RED RIVER COUNTY, TEXAS NO. 11

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS — SHEET NUMBER 12

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

RED RIVER COUNTY, TEXAS — SHEET NUMBER 13

13

N

2 665 000 FEET

785 000 FEET

775 000 FEET

2 690 000 FEET

(Joins sheet 8)

(Joins sheet 14)

(Joins sheet 18)

LAMAR COUNTY

RED RIVER COUNTY

INDEFINITE BOUNDARY

Woodland

WOODLAND CEMETERY

G.P.

Bible Way Church

Pecan Bayou

Pine Creek

Little

410

195

Scale 1:20000

1 Mile

5000 Feet

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 13

14

N

(Joins sheet 9)

2 710 000 FEET

785 000 FEET

775 000 FEET

2 690 000 FEET

(Joins sheet 15)

(Joins sheet 13)

(Joins sheet 19)

Addielou

CALHOUN CEMETERY

Little Pine Creek

First Pecan Bayou

Pecan Bayou

Scale 1:20000

1 Mile 5 000 Feet

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

1¼ 5 000

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 14

RED RIVER COUNTY, TEXAS — SHEET NUMBER 15

15

RED RIVER COUNTY, TEXAS NO. 15

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 715 000 FEET

785 000 FEET

775 000 FEET

2 735 000 FEET

(Joins sheet 10)

(Joins sheet 14)

(Joins sheet 16)

(Joins sheet 20)

N

1 Mile 0 5000 Feet

Scale 1:20000

1 000 0 1 000 2 000 3 000 4 000 5 000

¼ ½ ¾ 1

Little Pine Creek

Pine Creek

Lick Creek

TUGGLE SPRINGS CEMETERY

2118

KuB WkA Wr VeD RsC BeB WoE water Na Th FrA WhD McC Pa Gf AfB WoC

16

N

1 Mile

5000 Feet

0

0

Scale 1:20000

(Joins sheet 15)

(Joins sheet 11)

2 760 000 FEET

790 000 FEET

775 000 FEET

2 740 000 FEET

(Joins sheet 21)

(Joins sheet 17)

WoC
AtB
AfB
WkA
Wr
KuB
VeF
WhD
Little Pine Branch
Th
McC
McE
VeD
BeB
Snell Creek

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 16

RED RIVER COUNTY, TEXAS NO. 17

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(Joins sheet 12)
(Joins sheet 16)
(Joins sheet 22)
(Joins inset, sheet 23)

2 765 000 FEET
790 000 FEET
2 785 000 FEET
775 000 FEET

N

1 Mile
5000 Feet

Scale 1:20000

Greenwood
Acworth School
Acworth
BACHMAN CEMETERY
Lick Skillet Cut-Off
RIVER
RED
OKLAHOMA BOUNDARY
McCURTAIN COUNTY INDEFINITE
Greenwood Branch
Sulphur Springs Creek
Collier Creek
water
1159

AfB BeB DeA FrA HaB Ko KuB Mu Mx Na Of Rc Rd Rf Th VeD VeF Wa WhD WkA WoE Wr

RED RIVER COUNTY, TEXAS — SHEET NUMBER 18

(18)

N

(Joins sheet 13)

2 690 000 FEET

770 000 FEET

(Joins sheet 19)

1 Mile

5000 Feet

0

0

Scale 1:20000

LAMAR COUNTY

BOUNDARY

INDEFINITE

760 000 FEET

(Joins sheet 25)

2 670 000 FEET

AfB
BeB
KuB
Na
Pa
RsC
Th
WoC
WoE
Wr

Little Pine Creek

Pine Creek

Bayou

Damerdale

410

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 18

RED RIVER COUNTY, TEXAS — SHEET NUMBER 19

RED RIVER COUNTY, TEXAS NO. 19

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 690 000 FEET

770 000 FEET

(Joins sheet 14)

(Joins sheet 18)

(Joins sheet 20)

(Joins sheet 26)

760 000 FEET

2 715 000 FEET

19

N

1 Mile

5000 Feet

Scale 1:20000

RED RIVER COUNTY, TEXAS — SHEET NUMBER 20

20

N

(Joins sheet 15)

2 735 000 FEET

770 000 FEET

760 000 FEET

2 715 000 FEET

(Joins sheet 19)

(Joins sheet 21)

(Joins sheet 27)

1 Mile

5000 Feet

0

Scale 1:20000

Pecan Bayou

Denwiddie Bayou

Blanton Creek

Pecan Bayou

Mt Pleasant Church

2118

AfB BeB BkA Gf KeD KuB Na RsC Th WkA WoC WoE Wr

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 20

RED RIVER COUNTY, TEXAS — SHEET NUMBER 21

RED RIVER COUNTY, TEXAS NO. 21

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 740 000 FEET

770 000 FEET

760 000 FEET

2 760 000 FEET

(Joins sheet 16)

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 28)

21

N

1 Mile

5000 Feet

Scale 1:20000

Creek

Snell

Collier

Negley

Hopewell Church

HOPEWELL CEMETERY

2118

37

BeB KuB WkA Wr AfB WoC Th VeF VeD McE McC WhD FrA KeD RsC WoE Na

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 23

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(Joins inset)

2 790 000 FEET

775 000 FEET

McCURTAIN COUNTY OKLAHOMA

INDEFINITE

Bryarly Cut-Off

RED RIVER

McCURTAIN COUNTY OKLAHOMA INDEFINITE BOUNDARY

Eagle Bend Cut-Off

Deadman Branch

Tenkiller Branch

Bryarly

intermittent

int

Mx DeA Rf AfB WkA Of Ko Rc Rd KuB WoE BeB Gf WoC Wr WhD VeD Th McE McC Mu Ok

2 789 000 FEET

780 000 FEET

775 000 FEET

2 794 000 FEET

(Joins upper left)

(Joins sheet 17)

(Joins sheet 22)

(Joins sheet 24)

(Joins sheet 30)

2 810 000 FEET

760 000 FEET

23

N

1 Mile

5 000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

(24)

N

1 Mile

5000 Feet

0 0

Scale 1:20000

1 5000 ¾ 4000 ½ 3000 ¼ 2000 0 1000

2 841 000 FEET

764 000 FEET

760 000 FEET

2 838 000 FEET

(Joins lower right)

(Joins inset, sh 81)

3000 AND 4000-FOOT GRID TICKS

2 835 000 FEET

775 000 FEET

760 000 FEET

2 815 000 FEET

(Joins sheet 23)

(Joins sheet 31)

(Joins inset)

McCURTAIN COUNTY OKLAHOMA

McCURTAIN COUNTY INDEFINITE

OKLAHOMA BOUNDARY INDEFINITE

McCURTAIN CO OKLA BOUNDARY INDEFINITE

Cut - Off

Eagle - Bend

RED RIVER

Pecan Bayou

Ko Of Ok Rc Rd DeA

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 24

RED RIVER COUNTY, TEXAS — SHEET NUMBER 25

25

N

(Joins sheet 18)

2 670 000 FEET

755 000 FEET

Pine Creek

Little Pine Creek

Denwiddie Bayou

Cross Road

Freeman Branch

Williams Creek

410

BOUNDARY

LAMAR COUNTY

INDEFINITE

(Joins sheet 26)

(Joins sheet 32)

2 690 000 FEET

740 000 FEET

1 Mile

5000 Feet

Scale 1:20000

RED RIVER COUNTY, TEXAS NO. 25

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

26

N

(Joins sheet 19)

2 710 000 FEET

755 000 FEET

1 Mile

5 000 Feet

0

0

Scale · 1 : 20000

(Joins sheet 25)

¼

1 000

½

2 000

¾

3 000

1

4 000

5 000

Midway

Liberty Church

BLANTON CREEK CEMETERY

Blanton Creek

Mud Creek

Creek

2120

740 000 FEET

2 695 000 FEET

(Joins sheet 33)

(Joins sheet 27)

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 26

RED RIVER COUNTY, TEXAS — SHEET NUMBER 27

27

N

2 715 000 FEET

755 000 FEET

745 000 FEET

2 740 000 FEET

(Joins sheet 20)

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 34)

Blanton Creek

White Oak Bayou

Bayou

Campground

YOUNGS CHAPEL CEMETERY

New Haven Church

2120

Scale 1:20000

1 Mile 5000 Feet

RED RIVER COUNTY, TEXAS NO. 27

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(28)

N

Scale 1:20000

1 Mile | 0 | ¼ | ½ | ¾ | 1

5 000 Feet | 0 | 1000 | 2000 | 3000 | 4000 | 5000

(Joins sheet 21)

(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 35)

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 29

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

30

RED RIVER COUNTY, TEXAS — SHEET NUMBER 30

N

(Joins sheet 23)

2 810 000 FEET

1 Mile
5 000 Feet
0
Scale 1:20000
1 000 ¼ 2000 ½ 3000 ¾ 4000 5000

(Joins sheet 29)

745 000 FEET

2 790 000 FEET

(Joins sheet 37)

755 000 FEET

(Joins sheet 31)

AfB McC McE WhD Mu WkA Rd DeB DeA Of Mx Wr KuB FrA Rc VeD VeF BeB Th Gf Ts MoD2 WoC WoE KeD Kb

Tanyard Branch
Bayou
Pecan
Schaffline Creek
West Creek
Camely Creek
Beaverdam Creek

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 30

RED RIVER COUNTY, TEXAS NO. 31

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

32

N

(Joins sheet 25)

2 690 000 FEET

740 000 FEET

1 Mile 5000 Feet

0 0

Scale 1:20000

1 000 2000 3000 4000 5000

¼ ½ ¾ 1

LAMAR COUNTY

INDEFINITE BOUNDARY

RED RIVER COUNTY

TEXAS

Detroit

Wildcat Creek

Scatter Creek

Freeman Creek

Liberty Creek

Pacific and Texas

SEWAGE DISPOSAL PONDS

LONGSTREET CEMETERY

DETROIT CEMETERY

NEW HOPE CEMETERY

DEAN CEMETERY

New Hope Church

82 2573 410 194

(Joins sheet 33)

(Joins sheet 39)

725 000 FEET

2 670 000 FEET

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 32

N

2 695 000 FEET

740 000 FEET

(Joins sheet 26)

(Joins sheet 32)

(Joins sheet 34)

(Joins sheet 40)

2 715 000 FEET

725 000 FEET

Bluff

Bagwell

Brooks Lake

Ward Creek

Scatter Creek

Coal Creek

TEXAS AND PACIFIC

1 Mile 5000 Feet

Scale 1:20000

RED RIVER COUNTY, TEXAS NO. 33

(Joins sheet 27)

(Joins sheet 33)

(Joins sheet 35)

(Joins sheet 41)

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 35

2 740 000 FEET

7 740 000 FEET

(Joins sheet 28)

(Joins sheet 34)

(Joins sheet 36)

(Joins sheet 42)

2 765 000 FEET

7 730 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

Little Creek

Bayou

Carroll Creek

North Lake

Vandalia

Slate Rock Church

JAMISON CHAPEL CEMETERY

FREE HOPE CEMETERY

DAM NO 3

WHITEMANS CHAPEL CEMETERY

Delaware Creek

Langford Creek

Joiner Creek

2283

1159

1700

37

RED RIVER COUNTY, TEXAS — SHEET NUMBER 36

36

N

(Joins sheet 29)

2 785 000 FEET

740 000 FEET

730 000 FEET

2 765 000 FEET

(Joins sheet 43)

(Joins sheet 37)

(Joins sheet 35)

Scale 1:20000

1 Mile

5 000 Feet

0 1 000 2 000 3 000 4 000 5 000

¼ ⅛ ¾ 1

Creek

Lake

Concord Church

Shiloh Church

Madras

WHITE ROCK CEMETERY

White Rock

Caney

White Rock Cr.

1700

1158

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 36

RED RIVER COUNTY, TEXAS — SHEET NUMBER 37

RED RIVER COUNTY, TEXAS NO. 37

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 790 000 FEET

740 000 FEET

730 000 FEET

2 810 000 FEET

(Joins sheet 30)

(Joins sheet 36)

(Joins sheet 38)

(Joins sheet 44)

Caney Creek

West Caney Creek

Beaverdam Creek

Martin Shiloh Church

1699

37

N

1 Mile

5 000 Feet

Scale 1:20000

RED RIVER COUNTY, TEXAS — SHEET NUMBER 38

38

N

(Joins sheet 31)

2 835 000 FEET

740 000 FEET

730 000 FEET

2 815 000 FEET

(Joins sheet 45)

1 Mile

5000 Feet

0

Scale 1:20000

(Joins sheet 37)

Little Creek

Beaverdam Creek

Beaverdam

McE Th AfB DeB DeA McC WoC WoE Wr Pa Na VeD VeF WkA MoD2 Kb Gf KeD BrC WpC GuD2

RED RIVER COUNTY

BOWIE COUNTY

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 38

(Joins sheet 32)

(39)

N

2 670 000 FEET

720 000 FEET

LAMAR COUNTY

BOUNDARY

INDEFINITE

Liberty

Middle Creek

Reno Creek

Cutland Creek

Na Creek

LIBERTY CEMETERY

Liberty

(Joins sheet 40)

(Joins sheet 46)

710 000 FEET

2 690 000 FEET

1 Mile 0 5000 Feet

Scale 1:20000

1 ¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

RED RIVER COUNTY, TEXAS NO. 39

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS — SHEET NUMBER 40

(40)

N

(Joins sheet 33)

2 715 000 FEET

720 000 FEET

710 000 FEET

2 695 000 FEET

(Joins sheet 47)

(Joins sheet 41)

Scale 1:20000

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

Catonville

CATONVILLE CEMETERY

LIBERTY CEMETERY

Liberty Creek

Scatter Creek

BuA BuB DaB EsC FeD2 Gf HoB Kb MaA Na Pa Th Ts WoC WoE WpE Wr AfB BrC

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 40

RED RIVER COUNTY, TEXAS — SHEET NUMBER 41

RED RIVER COUNTY, TEXAS NO. 41

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 720 000 FEET

720 000 FEET

(Joins sheet 40)

(Joins sheet 34)

(Joins sheet 42)

(Joins sheet 48)

2 740 000 FEET

710 000 FEET

41

N

1 Mile

5000 Feet

Scale 1:20000

SHAMROCK CEMETERY

THOMPSON CEMETERY

NEW SHAMROCK CEMETERY

Mabry

MC KENZIE CEMETERY

FAIRGROUNDS CEMETERY

FAIRVIEW CEMETERY

HARRIS CHAPEL CEMETERY

TEXAS AND PACIFIC

Bluff Creek

McCoy Creek

Clabbard Creek

Boggy Creek

BrC BuB CuD2 DaB FeD2 HoB MaA Na Pa Tr Ts WoC WoE Wr

RED RIVER COUNTY, TEXAS — SHEET NUMBER 42

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 42

RED RIVER COUNTY, TEXAS NO. 43

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 765 000 FEET

725 000 FEET

(Joins sheet 36)

(Joins sheet 42)

(Joins sheet 44)

(Joins sheet 50)

2 785 000 FEET

710 000 FEET

43

N

1 Mile

5000 Feet

Scale 1:20000

Jake Creek

Young Creek

Hurricane Creek

Rock Creek

White Creek

T&P Lake

TEXAS AND PACIFIC

RED RIVER COUNTY, TEXAS — SHEET NUMBER 44

(44)

N

(Joins sheet 37)

2 810 000 FEET

725 000 FEET

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 43)

(Joins sheet 45)

710 000 FEET

2 790 000 FEET

(Joins sheet 51)

English

English Church

Hurricane Creek

Kickapoo Creek

1699

114

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 44

RED RIVER COUNTY, TEXAS NO. 45

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(Joins sheet 38)
(Joins sheet 44)
(Joins sheet 52)

2 815 000 FEET
725 000 FEET
715 000 FEET
2 835 000 FEET

45

N

1 Mile
5000 Feet

Scale 1:20000

COUNTY
BOWIE

Henrietta Church

Beaverdam Creek
West Fork Harris Creek
Mill Creek
Mill Creek

114
911

RED RIVER COUNTY, TEXAS — SHEET NUMBER 46

46

N

(Joins sheet 39)

2 690 000 FEET

705 000 FEET

695 000 FEET

2 670 000 FEET

(Joins sheet 53)

(Joins sheet 47)

LAMAR COUNTY

BOUNDARY INDEFINITE

Cuthand Creek

Wildcat Creek

Reno Creek

Liberty Creek

Lake Prairie Creek

Gouching Creek

BETHEL CEMETERY

Fulbright

411G

411

410

1 Mile

5000 Feet

0

Scale 1:20000

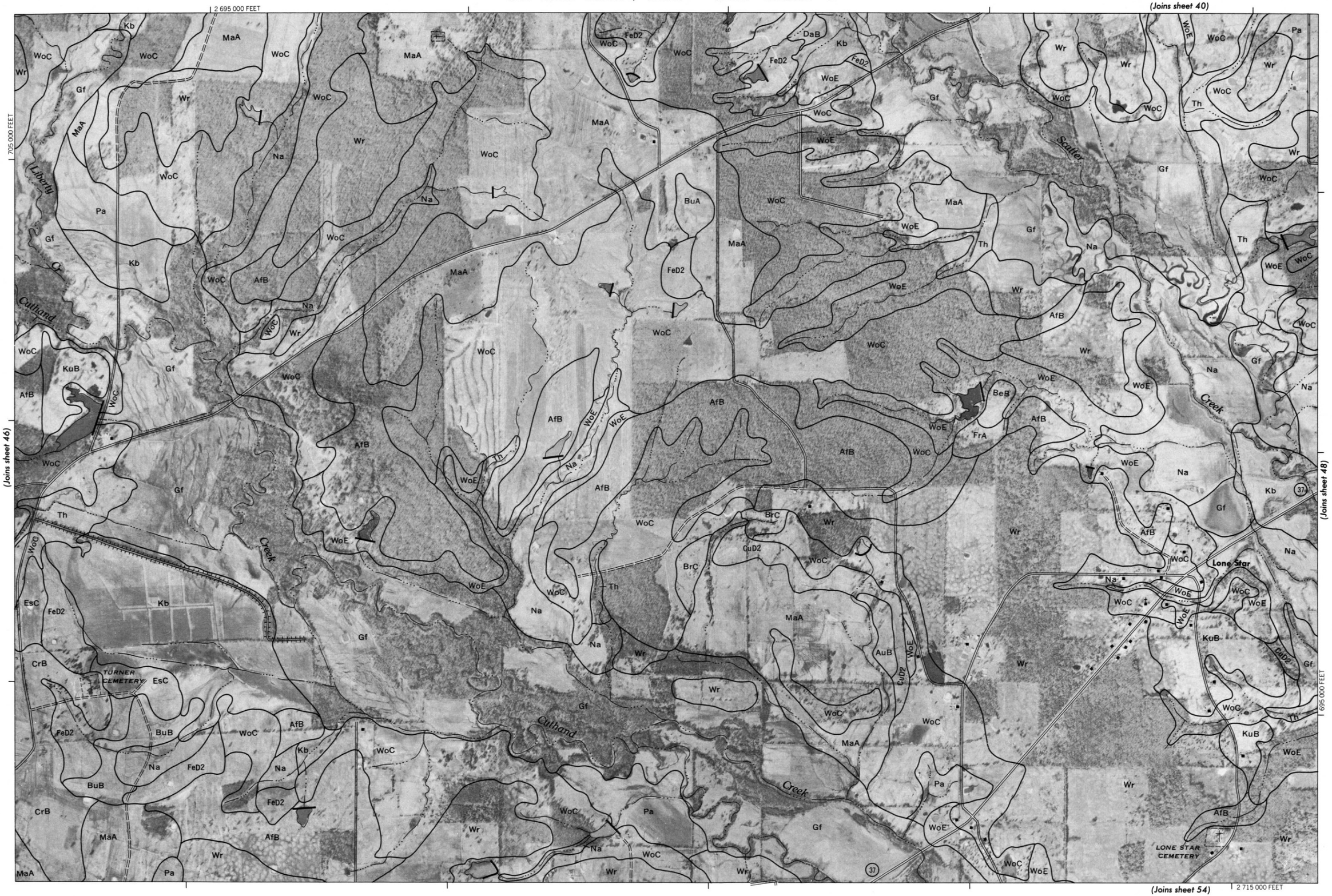
1 000 2 000 3 000 4 000 5 000

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 46

RED RIVER COUNTY, TEXAS NO. 47

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



47

N

1 Mile
5,000 Feet
Scale 1:20000
1 000 0 0 1 000
¼ ½ ¾ 1
2 000 3 000 4 000 5 000

(48)

N

(Joins sheet 41)

2 740 000 FEET

705 000 FEET

695 000 FEET

(Joins sheet 47)

(Joins sheet 49)

(Joins sheet 55)

2 720 000 FEET

1 Mile

5000 Feet

Scale 1:20000

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

McCoy

Brutton Creek

Clapboard Creek

Scatter Creek

Terry Creek

McCoy Creek

Burris Cr.

DAM NO 12

BREWSTER CEMETERY

909

37

Pa DaB WoC WoE HoB FeD2 MaA BuA FrA Wr Kb AuB CuD2 Ts BrC EsC BuB HoB Na Gf KuB Th BfC Tr

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 48

RED RIVER COUNTY, TEXAS NO. 49

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 745 000 FEET

705 000 FEET

695 000 FEET

2 765 000 FEET

(Joins sheet 42)

(Joins sheet 48)

(Joins sheet 50)

(Joins sheet 56)

49

N

1 Mile

5000 Feet

Scale 1:20000

Aikin Grove

Lanes Chapel

DAM NO 8

DAM NO 10

DAM NO 11

DAM NO 14

Langford

Boggy

Branch

Burkham

Creek

Kb

910

909

412

50

N

(Joins sheet 43)

2 790 000 FEET

710 000 FEET

1 Mile

5000 Feet

0 0

Scale 1:20000

(Joins sheet 49)

(Joins sheet 51)

695 000 FEET

(Joins sheet 57)

2 770 000 FEET

Annona

TEXAS AND PACIFIC

Young Creek

White Rock Creek

Jake Creek

Kickapoo Creek

Burkhand Branch

BuA BuB BrC DaB EsC FeD2 HoB MaA Ts WoC Wr Kb Pa WoE Na KuB AfB Gf

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 50

RED RIVER COUNTY, TEXAS — SHEET NUMBER 51

51

RED RIVER COUNTY, TEXAS NO. 51

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 790 000 FEET

710 000 FEET

(Joins sheet 44)

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 58)

695 000 FEET

2 815 000 FEET

N

Scale 1:20000

1 Mile

5000 Feet

52

N

(Joins sheet 45)

2 835 000 FEET

710 000 FEET

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 51)

0 0

¼ 1000

⅜ 2000

½ 3000

¾ 4000

1 5000

695 000 FEET

2 815 000 FEET

(Joins sheet 59)

Avery

Lone Pine Church

City Lake

Harris Creek

Mill Creek

PACIFIC AND TEXAS

BOWIE COUNTY

RED RIVER COUNTY, TEXAS NO. 52

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.

Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS — SHEET NUMBER 53

53

RED RIVER COUNTY, TEXAS NO. 53

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 670 000 FEET

690 000 FEET

(Joins sheet 46)

N

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 54)

675 000 FEET

(Joins sheet 60)

2 690 000 FEET

LAMAR COUNTY

BOUNDARY

INDEFINITE

Deport

Shadowland

Drain

Creek

Lake

Branch

Mustang

1149

271

410

411

BuA BuB CrB DaB EsC FeD2 HoB Kb MaA

(54)

N

(Joins sheet 47)

2 715 000 FEET

690 000 FEET

680 000 FEET

2 695 000 FEET

(Joins sheet 61)

(Joins sheet 53)

(Joins sheet 55)

1 Mile 5000 Feet

0 0

1 000

¼

2 000

½

3 000

¾

4 000

1

5 000

Scale · 1 : 20000

CrB MaA WoC Wr AfB Na WoE Gf Kb EsC Pa DaB BuB CuD2 FeD2 BuA HoB BrC Ts Th

411 37

Cuthand Creek Gouchy Creek Line Creek Branch

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 54

RED RIVER COUNTY, TEXAS — SHEET NUMBER 55

55

RED RIVER COUNTY, TEXAS NO. 55

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

2 720 000 FEET

690 000 FEET

680 000 FEET

2 740 000 FEET

(Joins sheet 48)

(Joins sheet 54)

(Joins sheet 56)

(Joins sheet 62)

N

Scale 1:20000

1 Mile 0 1 000 2 000 3 000 4 000 5 000 Feet

1 ¼ ½ ¾ 0 ¼ ½ ¾ 5000

Sherry

McCoy Creek

Scatter Creek

Cuthand Creek

Clapland Creek

PLEASANT HILL CEMETERY

CUTHAND CREEK

909

WoC WoE Th Wr Kb Gf AfB Gd Pa MaA DaB BrC Ts BuB Ka

RED RIVER COUNTY, TEXAS — SHEET NUMBER 56

56

N

(Joins sheet 49)

2 765 000 FEET

690 000 FEET

680 000 FEET

2 745 000 FEET

(Joins sheet 63)

(Joins sheet 57)

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 55)

Peters Prairie

South Lake

Pickett Creek

Boggy Creek

Lynch Cr.

Langford Creek

Heelan Branch

Sand Branch

CUTHAND CR.

water

910

412

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 56

RED RIVER COUNTY, TEXAS NO. 57

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

N

Scale 1:20000

1 Mile 5000 Feet

0 1000 2000 3000 4000 5000

(Joins sheet 51)

(Joins sheet 57)

(Joins sheet 59)

(Joins sheet 65)

2 810 000 FEET

680 000 FEET

690 000 FEET

2 795 000 FEET

Anderson Creek

White Oak Creek

Shaumee Creek

Crystal Lake

SAVANNAH CEMETERY

King Memorial Chapel

Gilliam Church

G.P.

1701

44

AfB BeB BeD FrA KeD KuB KuS Na RsC Th VeD VeF WhD WkA Wr WoC WoE

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 58

RED RIVER COUNTY, TEXAS — SHEET NUMBER 59

RED RIVER COUNTY, TEXAS NO. 59

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

2 815 000 FEET

690 000 FEET

680 000 FEET

2 835 000 FEET

(Joins sheet 58)

(Joins sheet 52)

(Joins sheet 66)

Avery

Anderson Creek

BOWIE COUNTY

59

N

1 Mile

5000 Feet

Scale 1:20000

RED RIVER COUNTY, TEXAS — SHEET NUMBER 60

60

N

1 Mile 5000 Feet

0 0

Scale 1:20000

¼ 1000 2000

⅛ 3000

¾ 4000

1 5000

(Joins sheet 53)

2 690 000 FEET

675 000 FEET

660 000 FEET

2 670 000 FEET

(Joins sheet 67)

(Joins sheet 61)

LAMAR COUNTY BOUNDARY INDEFINITE

Lake Mustang Dram

Mustang Cr

Creek

Rugby

Branch

Drain

Webber

Lake

Creek

Halesboro

271

410

38

AfB BuA BuB DaB EsC HoB Ka Kb MaA Pa WoC WoE Wr

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 60

RED RIVER COUNTY, TEXAS NO. 61

2 695 000 FEET

675 000 FEET

(Joins sheet 54)

(Joins sheet 60)

(Joins sheet 62)

(Joins sheet 68)

660 000 FEET

2 715 000 FEET

61

N

1 Mile

5000 Feet

Scale 1:20000

BOGATA

Rosalie

HINSON CEMETERY

Little Mustang Creek

Morrison Branch

Frances Creek

62

RED RIVER COUNTY, TEXAS — SHEET NUMBER 62

N

(Joins sheet 55)

2 740 000 FEET

675 000 FEET

1 Mile 5000 Feet

0 0

Scale 1:20000

1 000 2 000 3 000 4 000 5 000

¼ ½ ¾ 1

(Joins sheet 61)

(Joins sheet 63)

660 000 FEET

2 720 000 FEET

(Joins sheet 69)

Cuthand Creek

Pine Branch

Pine Branch

Faith Temple

909

1487

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 62

RED RIVER COUNTY, TEXAS NO. 63

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

63

N

Scale 1:20000

1 Mile

5000 Feet

2 745 000 FEET

675 000 FEET

665 000 FEET

2 765 000 FEET

(Joins sheet 56)

(Joins sheet 62)

(Joins sheet 64)

(Joins sheet 70)

Cuthand

Pickett Creek

Langford Creek

CREEK

Turner Lake

Sand Br

Ringo Creek

Gf, Gd, Ts, Tr, Ka, Kb, Pa, BrC, WoC, WoE, MaA, Wr, Th, FrA, RsC, FeD2, AfB, KuB, Na

910, 1487, 412, 9f10

RED RIVER COUNTY, TEXAS — SHEET NUMBER 64

N

1 Mile
5 000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

(Joins sheet 57)

(Joins sheet 71)

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS — SHEET NUMBER 65

65

2 795 000 FEET

(Joins sheet 58)

675 000 FEET

(Joins sheet 64)

(Joins sheet 66)

665 000 FEET

(Joins sheet 72)

2 815 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

Boxelder

Salem Church

Shawnee Church

Shawnee Creek

Crooked Creek

Creek

KeD, KuB, WoE, WoC, Th, AfB, BeB, RsC, FrA, Wr, CrB, DaB, FeD2, MaA, HoB, BrC, EsC, Na, Pa, BuB

RED RIVER COUNTY, TEXAS NO. 65

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

66

N

RED RIVER COUNTY, TEXAS — SHEET NUMBER 66

(Joins sheet 59)

2 835 000 FEET

675 000 FEET

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

Scale 1:20000

(Joins sheet 65)

665 000 FEET

(Joins sheet 73)

2 820 000 FEET

REHOBETH CEMETERY

MEDFORD CEMETERY

SHAWNEE CHAPEL CEMETERY

Carney Creek

Dillard Creek

Wr Creek

Peters Creek

BOWIE COUNTY

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 66

RED RIVER COUNTY, TEXAS — SHEET NUMBER 67

67

RED RIVER COUNTY, TEXAS NO. 67

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 670 000 FEET

1 655 000 FEET

(Joins sheet 60)

(Joins sheet 74)

2 690 000 FEET

645 000 FEET

DAMAR COUNTY

INDEFINITE BOUNDARY

MORRIS CHAPEL CEMETERY

Lake Drain

Br Creek

Mustang

Oak Branch

White Creek

Mustang

N

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 68)

0 1000 2000 3000 4000 5000

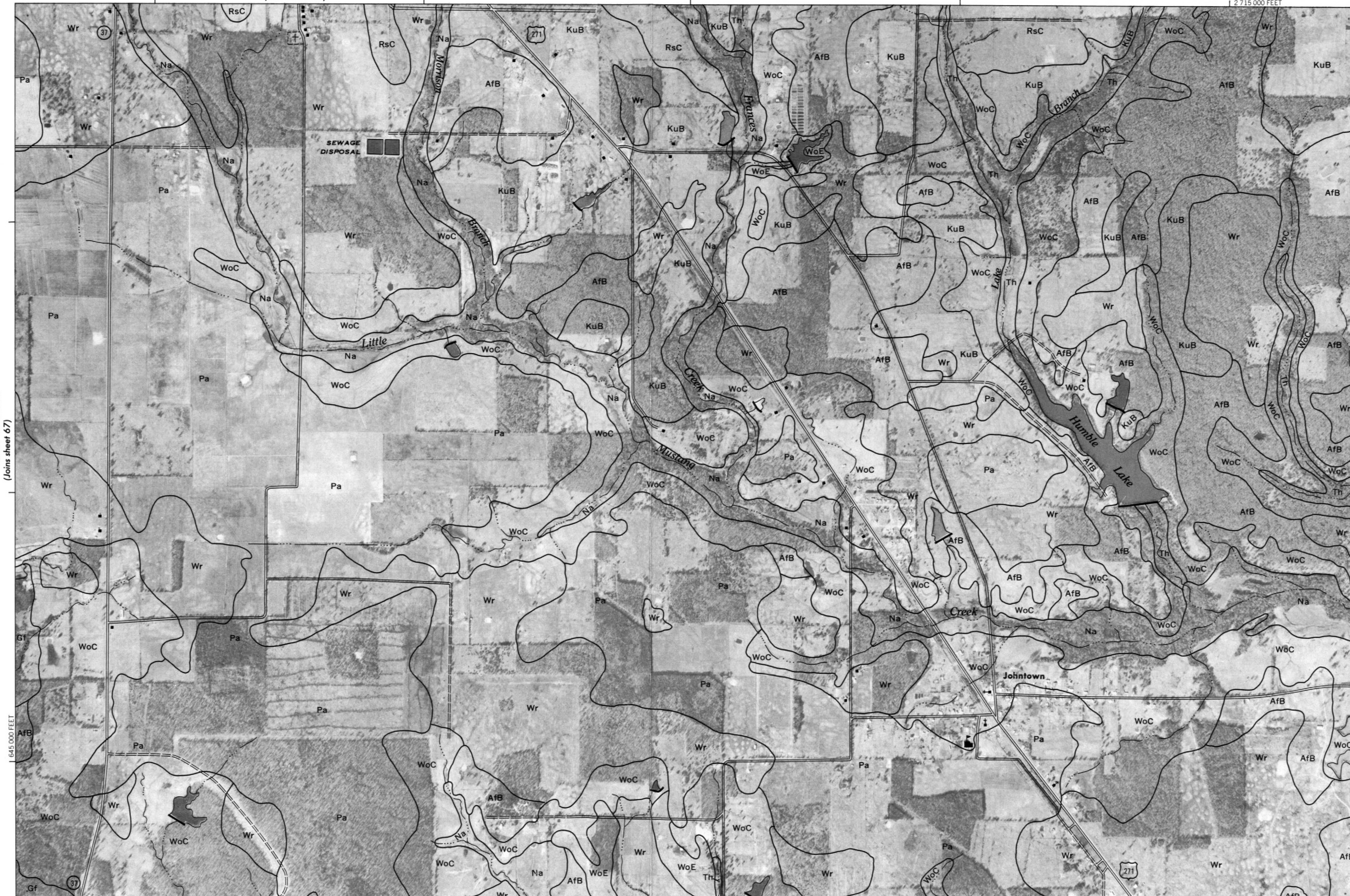
¼ ¼ ¼ ¼ 1

RED RIVER COUNTY, TEXAS — SHEET NUMBER 68

N

1 Mile
5000 Feet
0 0
1000
¼
2000
½
3000
¾
4000
5000
1

Scale 1:20000



This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

69

(Joins sheet 62)

2 720 000 FEET

655 000 FEET

(Joins sheet 68)

(Joins sheet 70)

645 000 FEET

(Joins sheet 76)

2 740 000 FEET

RED RIVER COUNTY, TEXAS NO. 69

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

1 Mile

5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

Scale 1:20000

RED RIVER COUNTY, TEXAS — SHEET NUMBER 70

70

N

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

Scale 1:20000

(Joins sheet 63)

(Joins sheet 69)

(Joins sheet 71)

(Joins sheet 77)

2 765 000 FEET

660 000 FEET

645 000 FEET

2 745 000 FEET

Ranger Creek

Whiteoak Creek

Maple Creek

McKENZIE CEMETERY

Th Cr

Wr AfB KuB WoC Th WoE Pa Na BrC DaB FeD2 FrA KbB RsC Kb

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 70

RED RIVER COUNTY, TEXAS NO. 71

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

71

N

2 770 000 FEET

660 000 FEET

(Joins sheet 64)

(Joins sheet 70)

(Joins sheet 72)

(Joins sheet 78)

2 790 000 FEET

645 000 FEET

CUTHAND

Kickapoo Cr.

FTA

Maple Creek

Flat Creek

CREEK

Scale 1:20000

1 Mile 5000 Feet

Ka Kb KuB Pa Th Wr WoC WoE AfB FeD2 Na Gf

RED RIVER COUNTY, TEXAS — SHEET NUMBER 72

72

N

(Joins sheet 65)

2 815 000 FEET

660 000 FEET

1 Mile

5000 Feet

0

Scale 1:20000

(Joins sheet 71)

1 000 Feet

¼

2000

½

3000

¾

4000

1

5000

645 000 FEET

(Joins sheet 79)

2 795 000 FEET

(Joins sheet 73)

WoC WoE Wr Th KuB Pa Ka BrC AfB CrB BuB HoB EsC Na MaA Gf Kb RsC

Crooked Creek

Shawnee Creek

Cottonwood Creek

Elm Creek

FM

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 72

RED RIVER COUNTY, TEXAS — SHEET NUMBER 73

RED RIVER COUNTY, TEXAS NO. 73

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 820 000 FEET

660 000 FEET

650 000 FEET

2 840 000 FEET

(Joins sheet 66)

(Joins sheet 72)

(Joins sheet 80)

BOWIE COUNTY

73

N

Scale 1:20000

1 Mile 5000 Feet

74

RED RIVER COUNTY, TEXAS — SHEET NUMBER 74

(Joins sheet 67)

(Joins sheet 75)

N

1 Mile 5000 Feet

0 0

Scale 1:20000

1000 2000 3000 4000 5000

1/4 1/2 3/4 1

2 690 000 FEET

2 670 000 FEET

630 000 FEET

640 000 FEET

LAMAR COUNTY BOUNDARY INDEFINITE

DELTA CO.

Brushy Creek

SULPHUR RIVER

FRANKLIN COUNTY

SULPHUR RIVER BOUNDARY INDEFINITE

FRANKLIN COUNTY

Dawson Lake

Mustang Cr

MC CRORY CEMETERY

196

37

Kb Wr Na FrA WoC WoE Ka Va AfB Pa Th Gf MaA FeD2

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 74

RED RIVER COUNTY, TEXAS — SHEET NUMBER 75

75

N

RED RIVER COUNTY, TEXAS NO. 75

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 695 000 FEET

640 000 FEET

630 000 FEET

2 715 000 FEET

(Joins sheet 68)

(Joins sheet 74)

(Joins sheet 76)

River Crest School

River Crest Lake

GRAVEL PIT

Mustang Creek

SULPHUR RIVER

FRANKLIN COUNTY

271

37

1 Mile

5000 Feet

Scale 1:20000

RED RIVER COUNTY, TEXAS — SHEET NUMBER 76

76

N

(Joins sheet 69)

2 740 000 FEET

1 Mile

5000 Feet

0

0

Scale 1:20000

(Joins sheet 75)

1/4

1000

2000

1/2

3000

3/4

4000

5000

1

2 720 000 FEET

630 000 FEET

640 000 FEET

(Joins sheet 77)

AfB BrC Pa WoE Na Gf DaB WoC Wr FeD2 EsC Kb

Little Mustang Creek

Stout Lake

River Crest Lake

Cheetwood Lake

G.P.

271

SULPHUR RIVER

FRANKLIN COUNTY

TITUS COUNTY

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 76

RED RIVER COUNTY, TEXAS — SHEET NUMBER 77

77

RED RIVER COUNTY, TEXAS NO. 77

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 745 000 FEET

2 765 000 FEET

640 000 FEET

630 000 FEET

(Joins sheet 70)

(Joins sheet 76)

(Joins sheet 78)

N

1 Mile

5 000 Feet

Scale · 1 : 20000

1 000 0 0 1 000 2 000 3 000 4 000 5000

BrC DaB Wr Th Pa WoC KuB FaD2 AfB Na Gf WoE Kb

SULPHUR RIVER CHANNEL

Elbow Lake

SULPHUR RIVER

Whiteoak Creek

TITUS COUNTY

78

RED RIVER COUNTY, TEXAS — SHEET NUMBER 78

N

(Joins sheet 71)

2 790 000 FEET

645 000 FEET

(Joins sheet 77)

(Joins sheet 79)

630 000 FEET

2 770 000 FEET

1 Mile

5000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

AfB Afton clay, 1 to 3 percent slopes

Gf Gasil fine sandy loam

Kb Kaufman clay

Na Navo clay

Pa Patrick clay

Wr Wilson silty clay loam

WoC Woodtell fine sandy loam, 1 to 5 percent slopes

WoE Woodtell fine sandy loam, 5 to 12 percent slopes

FeD2 Frio clay, 5 to 12 percent slopes, eroded

Harts Bluff

Whiteoak Creek

RIVER

SULPHUR

TITUS COUNTY

Flat Cr

Slough

CUTHAND

Big

GREEK

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 78

RED RIVER COUNTY, TEXAS — SHEET NUMBER 79

79

RED RIVER COUNTY, TEXAS NO. 79

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

2 795 000 FEET

645 000 FEET

(Joins sheet 72)

(Joins sheet 78)

(Joins sheet 80)

(Joins sheet 81)

Shawnee Creek

Slough

Big Cutoff Slough

Hardison Lake

SULPHUR RIVER

TITUS COUNTY

CUTHAND CREEK

Elm Creek

Kb AfB Ka BrC Pa Na WoC WoE Wr Gf Th

N

1 Mile

5000 Feet

Scale · 1:20000

1000 AND 5000-FOOT GRID TICKS

2 830 000

613 000

612 000

MAXIMUM FLOOD POOL LINE

LAKE TEXARKANA

MORRIS COUNTY

2 840 000

630 000 FEET

2 815 000 FEET

RED RIVER COUNTY, TEXAS — SHEET NUMBER 80

(80)

N

1 Mile 5000 Feet

0 0

¼ 1000

½ 2000

¾ 3000

1 4000 5000

Scale 1:20000

(Joins sheet 79)

(Joins sheet 73)

2 840 000 FEET

645 000 FEET

630 000 FEET

2 820 000 FEET

(Joins sheet 81)

Roden Creek

Grassy Lake

SULPHUR RIVER

TITUS COUNTY

BOWIE COUNTY

CEDAR CREEK CEMETERY

Cedar Creek

WoE WoC Pa Wr Na KuB CrB AfB Kb Th Gf BeB

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately postboned.

RED RIVER COUNTY, TEXAS NO. 80

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

RED RIVER COUNTY, TEXAS NO. 81